Volume 28 OCTOBER, 1921 Number 2

MACHINERY

THE INDUSTRIAL PRESS Publishers, 140-148 LAFAYETTE ST., NEW YORK

Better Machine Tools

Timken performance charts are laid out in years; and the service elements in terms of hundreds of millions of revolutions at speeds of more than 3,000 r p m.

No one of the more than 60,000,000 Timken Tapered Roller Bearings now in service has been recommended for its service except on the basis of tried and known performance. Timken Tapered Roller Bearings are applicable in every industry

—because Timken Tapered Roller Bearings perform most satisfactorily where demands both of high speed and heavy load are excessive.

Timken performance is quite readily accounted for because Timken Tapered Roller Bearings

—carry radial load, thrust load, and resultant loads continuously and simultaneously

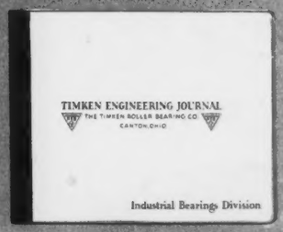
—function uniformly satisfactorily throughout the entire speed and load range

—carry more load per unit space required

—are adjustable for the wear which *must* follow motion.

The Timken Roller Bearing Co, Canton, O

Timken Tapered Roller Bearings for Machinery, Industrial Appliances, Passenger Cars, Trucks, Tractors, Trailers and Farm Implements



The Timken Engineering Journal containing authoritative data on better machine tools of all descriptions, mine equipment, road machinery, electrical equipment, printing presses, pumps and hundreds of other industrial and machinery appliances, is available upon request.

TIMKEN *Tapered* ROLLER BEARINGS

"The Recording Instrument Idea"

is strongly fixed in the minds of thousands of manufacturing executives. They appreciate the value of keeping in touch with operating conditions, and knowing what transpires during their absence, by means of the chart records furnished by

BRISTOL'S RECORDING INSTRUMENTS

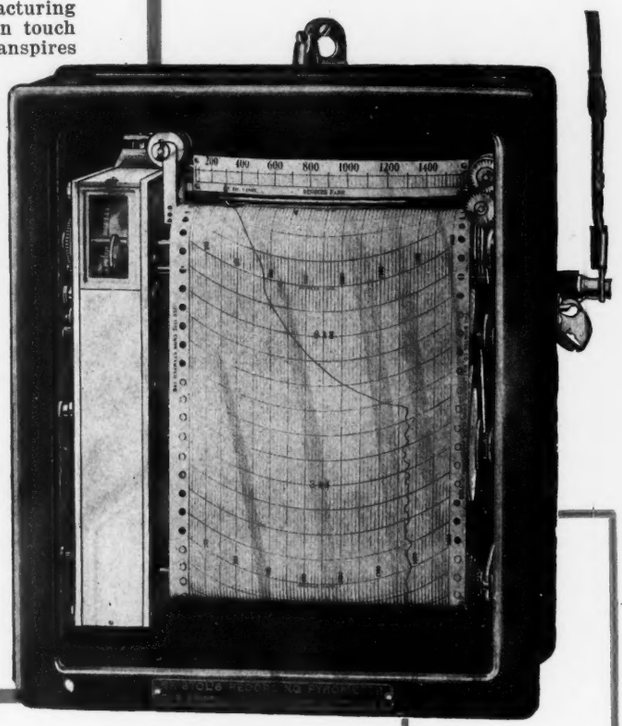
Yet, the more important function of "The Recorder" is for the workman who is responsible for the quality of the product. With a "Recorder" installed on the job he can tell at a glance just what conditions are now, what they have been, and in what direction they are leading. With this knowledge he can readily obtain close regulation—and even inexperienced workmen can do better work.

Control the Quality by Controlling Conditions

Get copy of Bulletin 291-E

THE BRISTOL COMPANY
WATERBURY, CONNECTICUT

TRADE MARK
BRISTOL'S
REG. U. S. PAT. OFFICE.

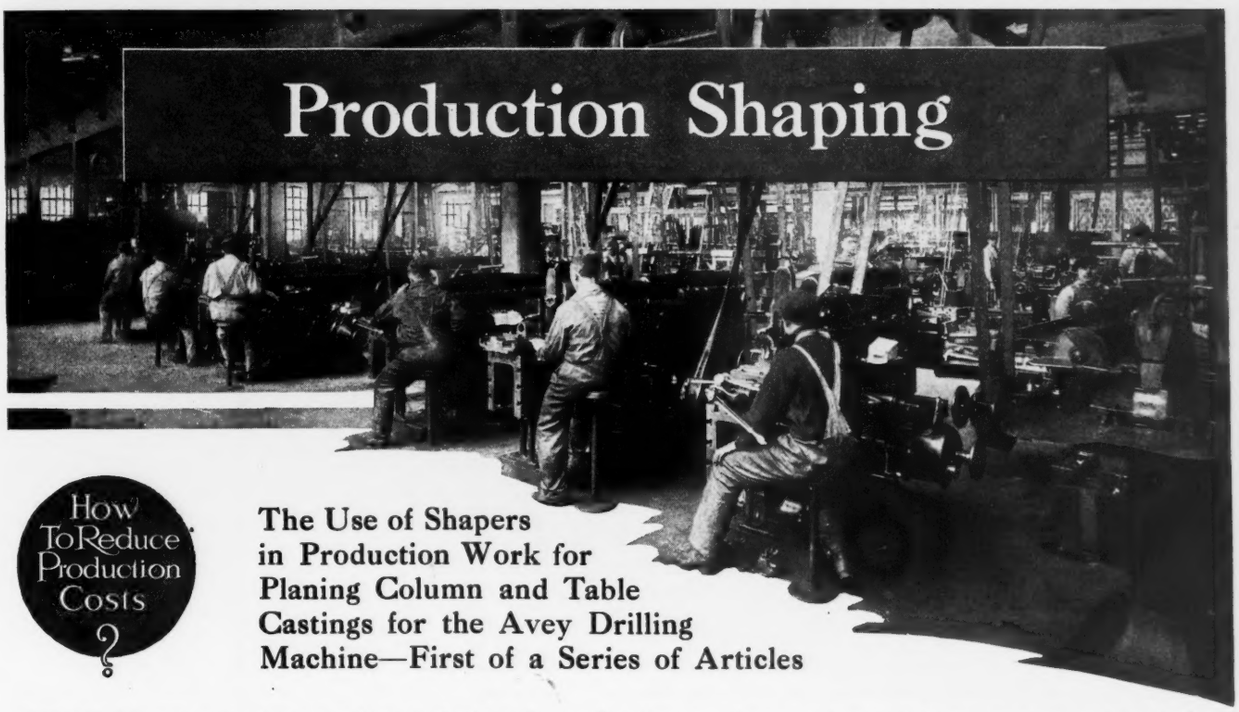


SIMONDS

Machine Shop Files

SIMONDS Files for machine shop use out-last other brands and cut faster because they are made of the finest steel and heat treated most scientifically. Every Simonds File is inspected and tested.

Production Shaping



How To Reduce Production Costs ?

The Use of Shapers in Production Work for Planing Column and Table Castings for the Avey Drilling Machine—First of a Series of Articles

SHAPERS are extensively used in tool-rooms for such work as the forming of die-blocks. By employing the various combinations of feed movements provided on machines of this type, pieces of intricate form can be machined—hence, the name "shaper." It is a general impression that the profitable use of these machines is restricted to tool and experimental work and similar operations, but although shapers are not extensively used on production work, there are many shops which have found them efficient for the performance of short planing and other similar operations on a production basis. For work that comes within their range they have several advantages. Among these may be mentioned a low initial investment, small maintenance cost, small amount of floor space required, and simplicity of operation, enabling them to be attended by low-priced labor.

The majority of the production jobs which are satisfactorily done on the shaper are those where the nature of the work is such that it is impracticable to take advantage of the increased efficiency resulting from the stringing up of a number of pieces of work on the table of a planer. It will be evident, then, that in cases where a choice must be made between setting up a single piece of work on a planer or on a shaper, the lower item of overhead that must be charged against the latter type of machine is usually of sufficient importance to represent a determining factor, provided the production time is not unreasonably high.

Shapers are not generally thought of as production machines, because their more common application is for tool-room, experimental and repair shop work; but it is a fact that shapers are capable of giving highly satisfactory results for the performance of short planing operations on a production basis, and for other production work within their range. This article describes the classes of work of this kind for which the shaper is adapted, and gives specific examples of advanced practice in production shaping.

At the plant of the Avey Drilling Machine Co., in Covington, Ky., the possibilities of the shaper as a production tool are well demonstrated. This firm uses shapers for five different manufacturing operations on the top column, the lower column, and the table of drilling machines, and as the dimensions of these parts vary considerably for different sizes of machines, it is necessary to have a number of shaper fixtures available.

Before starting upon a detailed description of the operations performed on these shapers, it may be well to make a general statement concerning the nature of the shaper work that is done. Obviously, planers are used in building Avey drilling machines, but there are certain castings, such as those for the table and the lower column for multiple-spindle machines, which are too wide to pass between the housings of any planer in this shop. Consequently, the machining of these castings presented the alternative of either purchasing a larger sized planer or of devising some other means of handling the work.

As there were only a moderate number of these pieces to be planed, the management felt that the investment in a planer of sufficient capacity for this work would not be warranted. A study of this problem made it apparent that, as the length of the surfaces to be planed on even the largest castings was quite short, a shaper with a 32-inch stroke would have sufficient capacity to handle the work, provided it was equipped with a fixture that would support the casting rigidly under the shaper ram. Such a machine could be purchased at a lower first cost and it would possess the further advantage of occupying less floor space.

The other type of planing operation for which shapers are used in this plant, is the machining of surfaces on castings that have a shoulder at the end of the finished surface, which makes it impracticable to set them up in a row on a planer table. For jobs of this

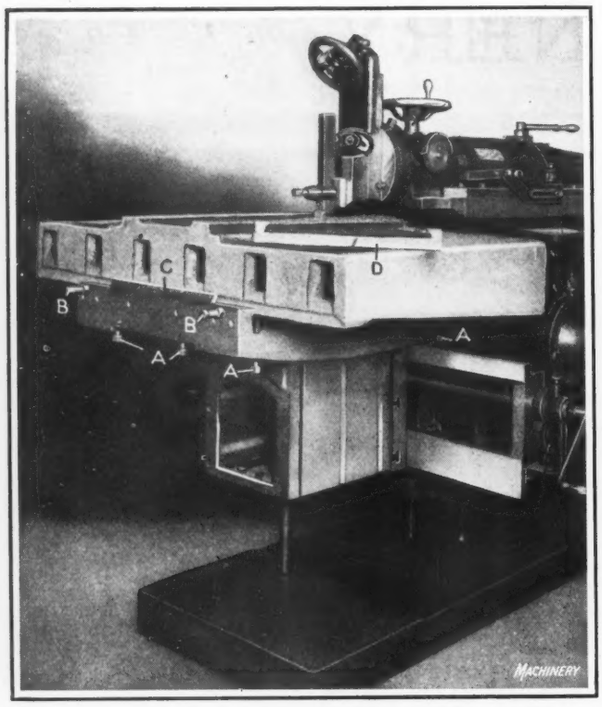


Fig. 1. Thirty-two-inch Shaper equipped for planing the Table Bearing on Columns of Multiple-spindle Drilling Machines

kind, the shaper is often found a more desirable tool than the planer because of the absolute control of the stroke, and as previously stated, when only one piece of work can be machined at one time, the smaller amount of floor space taken by the shaper is also an advantage.

Planing Dovetailed Bearing on Drilling Machine Column

Fig. 1 illustrates a 32-inch back-geared crank shaper built by the Cincinnati Shaper Co., Cincinnati, Ohio, which is used for planing the dovetailed table bearing on the lower column of an Avey No. 2 six-spindle drilling machine, this being the first operation performed on the casting. This dovetailed bearing is used as the locating point for the performance of subsequent operations. Naturally it must be located in approximately a central position on the casting and planed in accurate alignment with the side walls. To insure obtaining these results, a preliminary setting is made by first measuring from the two extreme outer edges to locate the center line of the casting, and then setting the tools in the proper position to plane the dovetailed bearing central with this line.

After this preliminary location has been accomplished, the casting is leveled up by means of five screws, four of which are shown at *A*. At the rear, the casting rests against two horizontal screws which may be adjusted to square it up with the line of travel of the shaper ram. The final clamping is accomplished by means of two screws *B* which are tightened against the casting and secured by means of lock-nuts. The tools are set for planing the dovetail by means of a gage *C*, and after the operation has been completed, the accuracy of the finished work is tested with a gage *D*.

In planing this dovetailed bearing, one roughing and one finishing cut are employed. Round-nosed roughing tools are used on the horizontal surfaces, while special rough-dovetailing tools are used on the angular faces. For taking the finishing cuts, the horizontal surfaces are machined with a square-nosed tool, while special finish-dovetailing tools are used on the angular faces. The fixture shown in Fig. 1 is also adapted for use in planing the lower columns of Avey No. 3 drilling machines with either four or six spindles. It will be seen that this fixture is set up on the regular table of the shaper.

Planing Dovetailed Column Bearing in Drilling Machine Table

Fig. 2 shows a 32-inch Cincinnati shaper equipped with a special extension at the front of the base to adapt it for the use of a fixture for holding the tables of Avey No. 3 four-spindle drilling machines while the dovetailed column bearing is being planed. As the castings come to this machine, a planing operation has been performed on the working surface of the table, which is at the back in the illustration; and the lower edge *A* of the casting has also been planed. These surfaces are utilized as locating points for setting up the work on the shaper. The operation consists of planing a dovetailed bearing at one side and a square seat for a dovetailed gib at the other side of the table bearing on the column. This bearing must be centrally located, and with that object in view, the casting is centered in the fixture by measuring from the two ends of the planed working surface of the table.

The casting rests in the fixture on blocks *B* that support the planed edge *A*, and by using blocks of different heights the same fixture may be employed for planing tables for different sized drilling machines. It will be apparent from the illustration that this work-holding fixture is of the so-called box form, and that the casting is slid in from one end and lowered into place on the supporting blocks *B*. This fixture is hung on the saddle by bolts in the T-slots, and takes the place of the regular table of the machine. When ordering a machine for handling this work, a special extension base *C* was specified, so that a support could be used at the front of the fixture to carry its weight, which is quite considerable. The work is clamped back in the fixture against a finished face that is arranged to come in contact with the previously planed working surface of the drilling machine table.

After adjusting the position of the casting so that it is properly centered, a preliminary clamping is accomplished by means of two screws *D* that force the casting back against the locating face at the rear of the fixture. Two screws *E* are next tightened to hold the casting down, and a screw inside the fixture is then raised under the center of the part to be planed, in order to support the thrust of the cut. Finally, the main clamping screw *F* is tightened, this screw being relied upon to accomplish the major part of the clamping action. In order to place control of adjust-

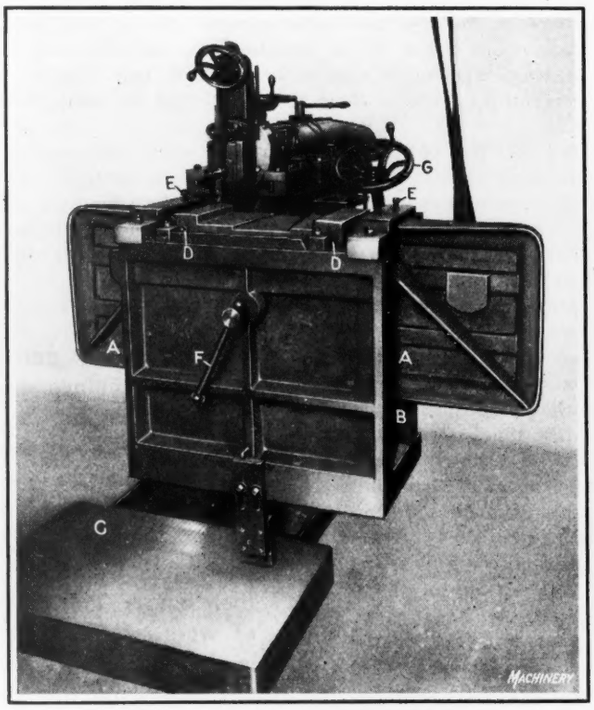


Fig. 2. Thirty-two-inch Shaper equipped for planing the Column Bearing in Tables of Multiple-spindle Drilling Machines

ments of the saddle on the shaper cross-rail within easy reach of the operator while at the front of the work-holding fixture, a special set of gearing, manipulated by a hand-wheel *G*, has been placed on the machine.

In planing the surfaces of the table bearing on the column, one roughing and one finishing cut are required. For the horizontal surfaces at the bottom of the bearing, a round-nosed roughing tool is employed, while a square nosed tool is utilized for running down the vertical side of the bearing, and a special rough-dovetailing tool is used for taking the first cut on the inclined side. For the finishing cuts, a square-nosed tool is used on the horizontal surfaces and for running down the side of the vertical surface, while a finish-dovetailing tool is utilized on the inclined side. The recess between the finished horizontal surfaces of the bearing is roughed out with a round-nosed tool, and no finishing cut is taken. The dovetailed bearing planed on this shaper is 12 inches long by 18⅜ inches wide by 1¼ inches deep. The material is cast iron, and the time required for the job is about two hours.

Planing Top Columns for Avey Drilling Machines

There are three planing operations to be performed on the top column of Avey drilling machines. Two of the surfaces to be machined are located in such a way that there is not sufficient clearance for a tool to pass over a string of castings when set up on the table of a planer. Consequently, the necessity of handling one casting at a time makes it a more economical proposition to perform this work on a shaper, for reasons that have already been mentioned. The third surface to be planed on these parts is the relatively small bottom face, where the top column is connected to the lower column member; and the fixture for holding the work for this operation is so designed that three castings may be set up at a time. In this way, the shaper is able to give a very satisfactory rate of production, and the output from a single machine is adequate to fulfill the requirements of the production schedule on this class of work.

Method of Setting up Top Column Castings for the First Operation

The first operation on these castings consists of planing the dovetail for the drilling head, and as this bearing is not only an important factor in governing the efficiency of operation of the drilling machine, but is also used as the locating point in setting up the work for all subsequent operations, it will be evident that great care must be taken in setting up the work and in planing this important bearing surface. Referring to Fig. 3, which shows a Cincinnati 24-inch shaper equipped for the first operation, it will be seen that the work is held in a box type of fixture that is bolted to the saddle T-slots in place of the regular shaper table.

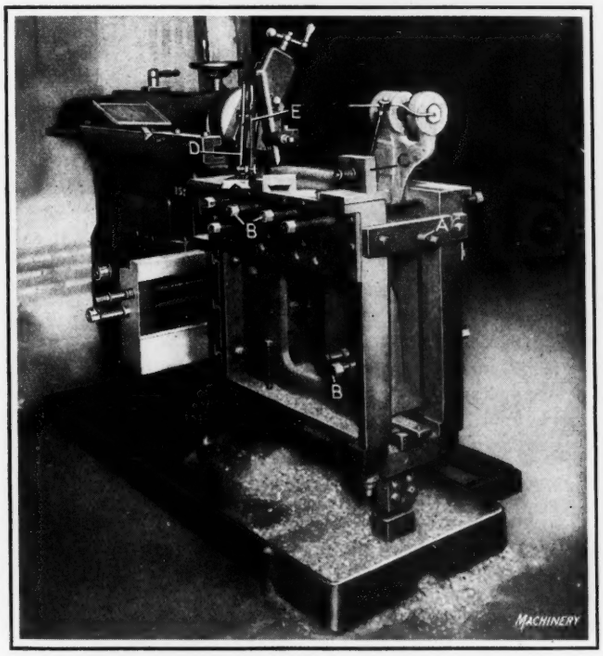


Fig. 3. Twenty-four-inch Shaper equipped for planing the Drilling Head Bearing on Columns of Single-spindle Drilling Machines

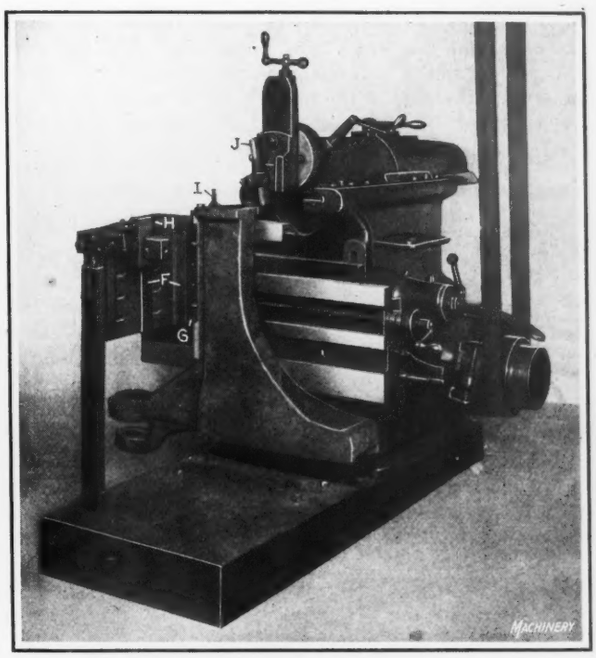


Fig. 4. Twenty-four-inch Shaper equipped for planing the Base of the Columns of Single-spindle Drilling Machines

Inside the box fixture there are two adjusting screws on which the casting rests, and they may be manipulated to provide for leveling the work so that the dovetailed bearing will be planed in proper relation to other fixed points. At the end nearest to the machine, there is provision for using a clamping bolt and strap (not shown) to hold the casting down, and at the opposite end of the fixture there will be seen a cross-bar and screw *A* for supporting the end thrust of the tool. Sidewise location and clamping of the casting in the fixture is accomplished by five bolts *B* at each side, which are tightened against the casting to locate and hold it in the desired position for planing.

Aligning Casting with Line of Travel of the Shaper Ram

Attention has been directed to the importance of lining the casting up accurately before starting the planing operation. The methods by which this result is accomplished are as follows: First, it is necessary to so locate the work that a line from the center of the spindle bearing hole to the center of the base of the column is parallel to the line of travel of the shaper ram. For obtaining this alignment, use is made of a special gage *C* that is carried on a base having a shoulder that fits over the inner edge of one of the top rails on the work-holding fixture, which is accurately finished for this purpose. A wooden plug is placed in the spindle bearing hole and rubbed with chalk so that the center of this hole can be marked, with reference to both the center of the opening and the outside of the boss.

Similarly, a chalk mark is placed on the top of the casting at the opposite end, so that a central line can be scribed in this chalk. After the fixture has been set up with the finished edge of the top rail in alignment with the line of travel of the shaper ram, gage *C* is used, as shown in Fig. 3, to compare the position of the scribed center of the spindle bearing opening with the center line scribed on the base of the column. The arm on which the measuring bar of gage *C* is carried is mounted on a pivot so that it may be swung against the tension of a coiled spring. In this way, it is an easy matter to first reach the spindle opening, and then

move the gage to the opposite end of the casting and swing the measuring bar down into engagement with the work. This tool affords a convenient means of measuring the distance from the edge of the top rail of the fixture to the two scribed lines. If the work has been properly aligned for planing, these two distances should be equal.

Adjusting the Horizontal Position of the Work

The next step in setting up the work is to bring the casting into a horizontal position, that is, to have it so located that as the casting lies in the work-holding fixture, the center of the spindle bearing hole will be at exactly the specified distance above the top surface of the opposite end of the casting, namely, 7⅛ inches for the size machine referred to. The test for this setting is accomplished by means of a surface gage and a special gage-bar on which there is scribed a graduation mark at 7⅛ inches from its lower end. The surface gage *D* is first set so that, with its base standing on the top rail of the work-holding fixture, the point of the scriber comes into contact with the center scribed on the wooden block in the spindle bearing hole. Then the special gage-bar *E* is stood vertically at the center of the opposite end of the casting, and the surface gage is moved over so that the position of the spindle center may be transferred to this gage. If the horizontal setting of the work is accurate, the point of the scriber will come into contact with the 7⅛-inch graduation on the gage-bar; otherwise, the horizontal position of the casting must be adjusted by means of the screw on which it is held in the fixture.

Testing Vertical Setting of Work

One other adjustment is still necessary to bring the work into the desired position for planing, namely, to ascertain whether it is standing in a vertical position. By first placing gage-bar *E* at one corner of the rear end of the casting and testing the position of the graduation line with the surface gage *D*, and then repeating this test with the gage-bar at the opposite corner of the work, a comparison can be made of the positions of the opposite corners of the casting relative to the horizontal top face of the work-holding fixture. The point of engagement between the scriber on the surface gage and the graduation line on bar *E* should be duplicated for the two settings if the work is properly located for planing. When all three of these adjustments of the setting of the work have been made, the screws *A* and *B* are finally tightened to maintain the accuracy of the location.

After the casting has been set up according to the previously described method, the outline of the dovetailed bearing to be planed is laid out on the work, in order to indicate the amount of excess metal that must be removed by planing. The first cut across the horizontal surface at the top of the bearing is taken with a round-nosed tool, and then a special rough-dovetailing tool is used on the inclined surfaces. The horizontal surfaces are next finished with a square-nosed tool, and a special finish-dovetailing tool takes the final cut on the inclined surfaces, thus completing the first operation. The production time on this job is forty-five minutes.

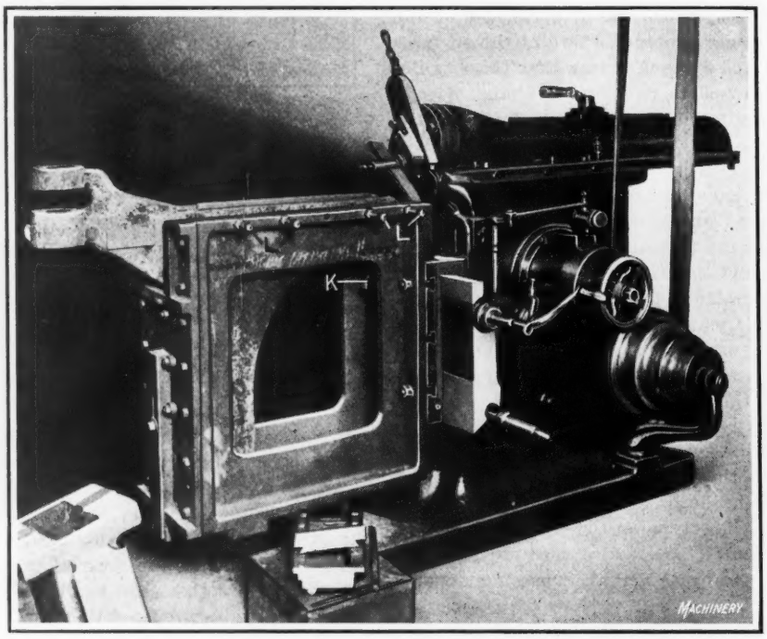


Fig. 5. Twenty-four-inch Shaper equipped for planing Bearing for Top Carriage on Drilling Machine Columns

Planing the Bottom Surface on the Top Column

Mention has already been made of the fact that the dovetailed bearing, previously planed on the top column casting to receive the drilling head, is used as the locating point in setting up the work for performing subsequent operations. Fig. 4 shows a 24-inch shaper built by Gould & Eberhardt, Newark, N. J., on which this work is performed; and in this connection, attention is drawn to the fact that although the shaper fixture is designed to hold three castings at a time, only one casting is shown in position in order that the arrangement may be more clearly illustrated. The method of setting up the work and the actual machining operation to be performed are quite simple. On the fixture there are three strips *F*, each of which has an inclined surface to bear against the angular face at one side of the dovetailed bearing that has been planed on the column.

After a piece of work has been slipped into place under locating strip *F*, a second adjustable strip *G*, which is secured to the fixture by bolts, is pushed into place against the opposite side of the dovetailed bearing and drawn up tight by the bolts, thus securing one piece of work in place for planing. Three pieces are set up in this way, and when they have all been set up, a clamping screw *H* is tightened to hold them securely in place and to support the end thrust of the tool. The planing operation is quite simple, consisting of facing off the bottom of the casting and of planing a tongue to fit into a groove planed in the top of the lower column casting.

The sequence of cuts taken during the performance of this operation is as follows: A round-nosed tool takes a roughing cut at the top of the casting, and the same tool is fed vertically downward to produce the necessary clearance at each side of the tongue. A duplex straddle tool is next used to finish-plane the sides of the tongue, and the accuracy of this job is tested with a snap gage *I*. Finally, the top of the work is finished with a round-nosed tool which has had a small flat surface stoned on its point. This tool is set at an angle, as shown at *J*, for convenience in reaching the work as it is held in the fixture. The production time on this job is twenty-five minutes.

Final Planing Operation on the Top Column

The final planing operation on the top column of the Avey drilling machine consists of planing the dovetailed bearing for the top carriage. This operation is performed on a 24-inch shaper as shown in Fig. 5, which is built by the Milwaukee Shaper Co., Milwaukee, Wis. This machine is equipped with a box jig similar to the one used for the first operation, except that the work is set differently. For taking the final cut, the casting is located from the dove-

tailed bearing planed in the first operation, the arrangement being similar to that explained in connection with the work-holding fixture illustrated in Fig. 4, with the exception that in the present case the dovetail in which the casting is held is located at the forward end of the fixture.

Castings are brought to this fixture by a trolley hoist and lowered through a space in the top, after which the clamping bolts are tightened. After a preliminary setting has been accomplished in this manner, the weight of the casting at the opposite end is supported by tightening a screw *K* that engages the under side of the work; and screws *L*, which are furnished with lock-nuts, are next drawn up in order to hold the sides of the work and prevent them from springing away from the cut. This is a matter of importance, because the walls of the casting are thin at the point where the dovetailed bearing for the top carriage is planed, and they require support in order to prevent distortion of the work.

After the roughing cut has been taken, it is also a matter of especial importance to loosen up the clamping bolts, which were tightened with a wrench before taking the roughing cut, and then screw these bolts up by hand until their points come into engagement with the casting, after which the lock-nuts are again tightened with a wrench. The purpose of resetting before taking the finishing cut is to prevent excessive pressure of the bolts which would spring the work out of shape and destroy the accuracy of the planed surface. On this job, roughing and finishing cuts are taken with the same sequence of tools previously referred to for operations on dovetailed bearings. The production time is seventy-five minutes.

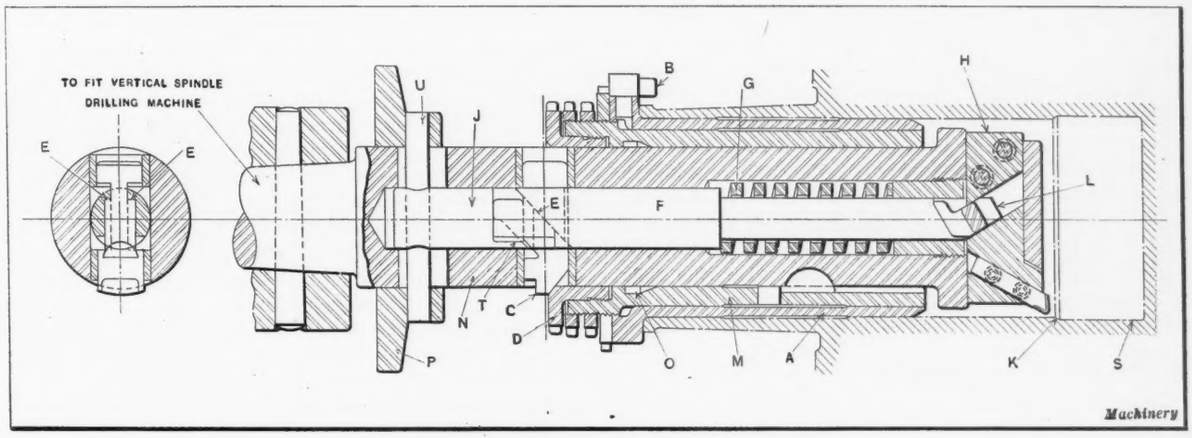
* * *

ROUGH-RECESSING TOOL FOR MOTOR CYLINDER BORE

The accompanying illustration shows a single-point boring tool which was developed to take the place of a wide forming-blade tool employed for the roughing operation in the combustion chamber of a motor cylinder. The wide blade originally used gave a fine finish, but its use necessitated the employment of extremely slow feeds and speeds, and on several occasions it had spoiled the cylinder bores by scoring them while being withdrawn from the work. In addition to these objectionable features, it proved an expensive tool to keep in proper condition. The design shown was adopted with the idea of producing a more satisfactory tool, which would be nearly automatic, positive in action, and not too expensive to make.

It will be noticed that bushing *A* acts as a pilot in the bore of the cylinder and is prevented from rotating by pin *B*, which comes into contact with the tangent wall between the two cylinders. When the spindle is fed downward, dog *C* comes in contact with the angular surface of collar *D* and is thrust inward. This inward movement causes shoulders *E* to bear on push-rod *F* against the action of spring *G*, which develops about 330 pounds pressure when compressed. As push-rod *F* moves forward, compressing spring *G*, the forged angular end *L* seated in tool-block *H* imparts an outward movement to the tool-block. Collar *D* is locked to bushing *M* which, in turn, is keyed to the main driving bar *N*. As dog *C* travels inward at the same time that it is being carried downward by bar *N*, the point of the tool is moved both radially and axially. The angles of the shoulders *E* and end *L* are, of course, calculated so that the walls of the combustion chamber and the walls of the cylinder bore will be joined by a conical surface *K* of the required taper, which in this case is 30 degrees.

Dog *C* travels downward inside bushing *M* for the full length of the cut or until the point of the tool is in the extreme downward position. At this time the point of the dog drops into slot *O*, or rather, the moment it passes over the slot the action of spring *G* forces it out, at the same time withdrawing the point of the tool from the surface *S* of the work. The stop on the machine also comes into play as a further safeguard, although a click that may be heard several feet away, which is made by the dog dropping into the slot, serves as a signal to the operator that the end of the cut has been reached. When in this position the tool may be withdrawn from the work without danger of scoring the cylinder walls.



Rough-recessing Tool for Combustion Chamber in Motor Cylinder

A new cut cannot be started until the tool has been completely withdrawn from the cylinder bore and placed in the correct position. To do this the operator must elevate the spindle to a sufficient height to bring flange *P* against adjustable pins (not shown), held in the nose of the machine. Flange *P* is pinned to the upper knock-out bar *J* and is a loose fit on the main driving bar *N* which is slotted to accommodate pin *U*. The force of the blow resulting from bringing flange *P* into contact with the pins in the nose of the machine forces the flange downward carrying with it knock-out bar *J* which seats on push-rod *F*. This action also carries rod *F* downward, providing clearance between its shoulders and the shoulders on dog *C* so that the beveled end *T* on the end of the knock-out bar will drop into the angular slot in dog *C*, thus forcing this member inward and allowing the outside nest of bushings to drop down, at which time the tool is ready for another cycle of operations. It will be noticed that the construction of the bushings and lock-nuts is such that a wide range of adjustment is provided.

W. W. R.

* * *

In 1920 Italy imported from Germany machinery and machine parts to a value of nearly 210,000,000 lire, as compared with imports to a value of 70,000,000 lire in 1913. In quantity, the imports amounted to 36,400 tons in 1920, as compared with 46,900 tons in 1913.

THE COST FACTOR IN FOUNDRY PRODUCTION

By J. P. GLYNN
Production Manager, The Elmwood Castings Co., Cincinnati, Ohio

Much of the cost burden entering into the manufacture of machinery can be lightened by putting the foundry on a more efficient productive basis. The manufacturer of machinery has never had a better opportunity than the present to go over the pattern situation and clean out obsolete types of patterns from his equipment. The development of new processes for turning out castings in quantity has done much to promote efficiency in the foundry. The manufacturer should not overlook these developments, but should take advantage of the modern equipment of the foundries and cooperate with the foundry by fitting his patterns so that they can be used for machine molding and other modern foundry appliances. The production of castings by hand methods, using the old type of pattern, is still followed by many manufacturers, and it is a vital consideration from an economical point of view to arrange such jobs for machine molding. In making or in contemplating changes of this kind, the manufacturer should solicit the cooperation of his foundrymen, and he will usually find that information will be freely given. An increase in the foundry production rate will be appreciated more in the days to come, when the labor shortage will again become acute. This shortage will be a big factor, especially in foundries where the percentage of apprentices is very low.

An example will best illustrate the savings that can be realized by making these change-overs. Consider a small bushing, say 3 inches in diameter and 4 inches long, with a 1¼-inch cored hole. Ordinarily this casting would be made by using one wood pattern, and if made on the bench would be run with other small patterns in order to fill up the flask, since in most cases only one pattern is furnished to the foundry. The molder can be expected to ram about twenty flasks per eight-hour day. Consider now this same job produced on a molding machine, under which conditions not less than six patterns would be mounted on a board or plate. It is safe to state that the molder, under ordinary conditions, would put up 100 molds per day, using a squeezer type machine. In many foundries a job of this kind is run on a piece-work basis and an even greater production obtained. It is evident that the old type bench-work patterns make this class of molding expensive and that the manufacturer is bearing this uncalled-for expense.

A certain machinery manufacturer once built and sent to his foundry an aluminum pattern for a 14-inch lathe apron plate. The pattern was to be used in conjunction with a wood follow-board by hand-ramming on the side floor. If the castings had been molded as intended, it would have been impossible to get much more than twelve per day. The pattern cost $50. In making the pattern to be molded this way, the foundry had not been consulted, so when the job reached the foundry a plated pattern was requested to be used on the molding machine, which would involve an additional cost of $62. The customer did not feel disposed to assume this extra cost, so the foundry management considered it economy to have a new pattern made at their own expense and run the job on a squeezer machine. This was done, and the production attained was forty pieces per day, as against twelve by the hand method. The weight of the casting was 43 pounds, so that 1720 pounds of castings were produced by machine instead of 516 pounds, which would have been the production by hand molding on the side floor.

One other factor which the production of castings by machine molding brings out is that the castings are drawn with the aid of a vibrator on the machine, and are always uniform in size, showing practically no parting line. This eliminates much grinding and chipping. By hand-molding methods, the pattern is rapped by using a hammer and a bar, and this often causes the castings to lack uniformity of size and weight. The money represented by this lack of uniformity often amounts to more than would be required to re-rig the patterns.

In connection with these changes the core-box equipment should receive attention. A large percentage of the dry-sand core work can be eliminated by changing the patterns to the machine-molded aluminum-plated type, because patterns of this type can often be so made as to produce their own core in green sand. In cases where dry-sand cores are required, the core-boxes should be so arranged that several cores can be made at one operation. There are many types of core-making machines in use, and it is just as important that the core-boxes be properly arranged for quantity production as it is that the patterns be so arranged.

* * *

ADVERTISING MACHINE TOOLS

By J. M. HENRY, Engineer, Pratt & Whitney Co., Hartford, Conn.

The editorial "Publicity that Pays" appearing in June MACHINERY refers to the class of information commonly contained in circulars and catalogues of machine tools and accessories. The writing of machine tool advertising is somewhat prosaic at its best, and time-worn shop expressions come naturally to the writer who must necessarily have a technical education in order to write intelligently. The vocabulary is limited to technical descriptive terms and, yet, copy must be so written that it carries an appeal to everyone concerned in the purchase of the machine. The copy must be general enough to interest everyone, and to write it is "some job," to say the least.

General managers and superintendents are concerned with production, longevity, ease of repairs and adjustments, elimination of breakdowns, and quality of materials, while the purchasing agent is mainly interested in the price. Here enters another factor that is frequently commented on: Why are not prices included in descriptive literature and advertisements? The answer is that in nine cases out of ten the customer has certain jobs in mind when looking for a machine. Extra equipment is usually necessary for the operations, and if prices were quoted in the circulars, inquiries would undoubtedly come in asking whether the price included a taper attachment, compound rest, etc. Thus, additional correspondence would be required that otherwise would be avoided when a clear direct inquiry is received for a specific price on a machine with certain equipment.

To convince an engineer that the machine described is the best on the market for his purpose requires clear forceful technical copy and illustrations. There was a time when the showing of illustrations of certain detailed mechanisms, together with clear descriptions of their functions, was considered as playing into the hands of one's competitors. In some quarters this idea still prevails, but it has been largely done away with, because any manufacturer who desires to know the construction of a machine built by a competitor has numerous other convenient ways of studying the machine minutely.

The description of machines must be clear enough to suit the foreman and the operator, and there is no reason why technical advertising cannot be clear, concise, and fully explanatory. The matter of phraseology should be carefully considered; for instance, is a machine "controlled" or "operated" by a lever? Is a brake "automatically applied" when it is dependent on the action of the operator, even though his action does not relate directly to the brake? Many similar examples might be mentioned. If phrases such as "unusual depth" and "ample bearings" are resorted to, suspicion is aroused, but the copy seems bare without them. Cooperation between the engineering and advertising departments is indeed imperative, and the writer does not see how satisfactory results can be obtained when this practice is not followed.

A PHASE OF SHOP PRODUCTION COSTS

By FREDERICK A. POPE, Assistant to General Superintendent, Blake & Knowles Works, East Cambridge, Mass.

While considerable progress has been made in developing systems for determining shop production costs, there are, nevertheless, many details of this work that are not always given adequate consideration. A factor which seriously affects the cost records, but which often escapes detection or is given little attention, is the cost of materials and labor entering into remachining or salvage work. The actual or total cost of spoiled parts that must be scrapped, including the cost of stock and machine work, may be entered in the spoiled-work account to be absorbed as part of the burden; or it may be added to the cost of machining the pieces that pass inspection and the material account credited for whatever scrap is recovered. In either of these cases the fact that work has been spoiled is readily shown by some form of replacement order, or by the scrap card.

The repair or remachining work, however, is a rather elusive element which, nevertheless, creeps into the labor costs in some shops and is not always shown up as clearly as that of work actually scrapped. The extra cost of time spent in remachining, or in some way making usable, pieces which are not correctly machined, but which can be corrected and used, may be considerable. When the work is subjected to a rigid inspection between practically all important operations, the regular inspection reports will give all data regarding necessary salvage work of this nature; so that with a knowledge of the facts thus provided, steps toward remedial measures can be taken by those responsible for production. But in a great many shops where a varied product is made, and process steps cannot be definitely established, such detailed inspection all along the line is not practicable. The duty of inspection then falls heavily upon the department foremen; this is, of course, admittedly unsatisfactory, but sometimes unavoidable.

Furthermore, where the product is of such a nature that much of the work is done without the extensive use of accurate limit gages, the skill and touch of the workman becomes one of the leading factors in the control of quality. Under such conditions it is inevitable that parts will occasionally pass through which are not quite up to standard. For example: A hole bored for a bushing may be found too small when the parts reach the assembling department, so that the piece must be sent back to be rebored; a set of bosses may not be faced off square and must therefore be returned for refacing; or the tapered end of a piston rod may be turned too small for the drive fit and for that reason be sent to the welder to be built up for re-turning. In such cases this work is commonly done on the authority of some department foreman, the regular order number being used. The cost of extra labor required therefore finds its way into the cost of that job.

Segregating Salvage Costs

As in the case of complete spoilage, this salvage expense may be considered, under some conditions, a necessary part of the cost of the job, but it is essential that some means be provided for segregating in the records the cost of all this extra work, at least temporarily, so that weaknesses in the shop methods or incompetence in the personnel may become known quickly and be traced by the management, and the necessity for these corrections reduced to a minimum. Even though the final cost of the job may carry this item and so be passed on to the purchaser, a disregard of its causes will encourage carelessness which results in increased production costs. Attention should be directed to this kind of expense by some special form of job ticket so that later, when making up the cost summaries, that proportion of the labor spent in remachining work will comprise a separate item.

The exact form of the remachine ticket is immaterial, the essential thing being that it include the data indicating the department and person responsible for the incorrect work, and that it have some prominent and distinguishing feature (color or name) so that it can be easily separated by cost clerks from the regulation job tickets.

With such a method, imperfect work may, by a simple routine process involving practically no additional clerical work, be brought to the attention of the proper executives. An analysis, based on this information and incorporated in a report to the various department heads concerned as well as to the management, will place the responsibility for errors where it belongs, and will stimulate greater care in those departments.

It may be remarked that without a separate inspection force, or thoroughly standardized detail costs to check this extra expense, a foreman can, if he wishes, correct and hide defective work before it leaves his department. While this is true to a certain extent, the greater part of such errors in machining will be discovered in subsequent operations by some other department through inability to get a proper set-up, or in the assembly department through failure to assemble parts without excessive and out-of-the-ordinary hand fitting.

* * *

COMPARISON OF WAGES AND PROFITS

Employes, in general, usually have no conception of the profits realized from their labors, and to this ignorance of facts may be attributed many of the prevailing erroneous impressions among employes that their employers make enormous profits. For instance, a workman knowing the selling price of a part which he has produced is likely to deduct his wage and the probable cost of the raw material from which the product is made, and believe that the remainder approximates the profit of the concern on the part. Obviously, this is not so, because he has neglected to allow anything for taxes, insurance, and other overhead charges, or for a reserve or surplus fund so necessary to pay expenses during periods of depression and for enabling enlargements to the business.

Actually, the profits of a concern are small in comparison to the wages paid its employes, and if the latter were educated to understand this, much of the dissatisfaction among wage earners would be avoided. The General Electric Co., Schenectady, N. Y., with its usual farsightedness, gives each employe annually a statement showing the actual profits in cents resulting from a dollar's worth of business, as well as the sum which the employes received. The last statement was an average for the three years 1918, 1919, and 1920.

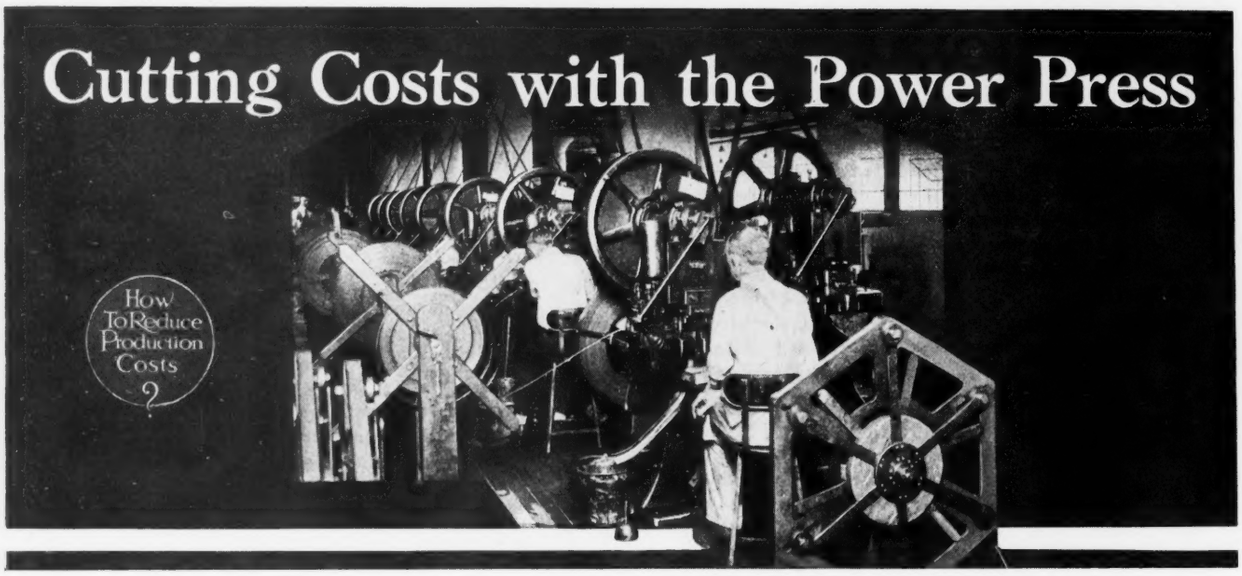
DISTRIBUTION OF EACH DOLLAR OF THE INCOME OF THE GENERAL ELECTRIC CO. FOR 1918, 1919, AND 1920

Distribution	Amount, Cents
Materials, supplies, etc.	40.6
Wages and salaries	41.7
Taxes	5.3
Transportation, telegraph, and telephone charges	2.5
Interest on bonds and notes	1.2
Dividend paid to stockholders	4.0
Surplus fund	4.7
Total	100.0

Machinery

The accompanying table shows the way in which each dollar of income was distributed. It shows that while the sum of 41.7 cents was paid in wages and salaries to the employes, only 8.7 cents was realized as a profit. Of the latter amount, 4 cents was paid to stockholders while 4.7 cents was placed in the reserve or surplus fund. Thus, it is evident that all the stockholders together received only about 9 per cent of the earnings of the employes.

Cutting Costs with the Power Press



How Material and Labor are Saved by the Use of Power Presses

By EDWARD K. HAMMOND

MANY executives in the mechanical industries, who pride themselves upon being well informed as to the latest methods applicable in manufacturing their products, do not realize the rapid strides which have been made in the design of dies for the performance of many operations not ordinarily expected to be done in a power press. Several advantages are to be gained by the substitution of stampings or drawn work for parts produced by other methods. Most important among these are the reduction in the cost of labor and material; the possibility of making parts of equal strength, but with a weight of only one-third that of parts produced by other methods (thus saving two-thirds the amount of metal formerly used); and last, but far from least, when rapidity in the filling of orders is an important factor, the ability of the power press to handle its work with extreme speed. A single downward and return stroke of the ram completes an operation, and, therefore, the rates of output attained in the production of all classes of stampings and drawn work are likely to be far in excess of those secured where the same parts are produced by some other method. For these reasons the power press is often an important factor in reducing costs.

Range of Work Done by Power Presses

Probably there are few machines that are employed for the production of as wide a range of work as power presses. The work handled by power presses extends all the way from small instrument parts, which are frequently made by treadle-operated presses of small size, up to such work as motor car bodies and parts of steel railway cars. Sheet steel of a thickness up to about ½ inch is easily worked under large presses. The machines themselves run all the way from small bench equipment, operated by foot pressure, up to machines with crankshafts over 2 feet in diameter, strokes of 4 feet, and a capacity up to 24 feet between the housings. Some machines constructed during the last few years weigh 700,000 pounds and over. One press for forming motor truck rear axle housings, recently constructed, weighs over 400,000 pounds.

During periods of great industrial activity, when there is a strong demand for most manufactured products, and prices exhibit a rising tendency, production costs are not always as carefully scrutinized as they should be; but when business slows down and prices begin to fall, the need for economy in production becomes apparent, and manufacturers begin to examine their methods and seek new ways for reducing production costs. In many instances, it will be found that work formerly produced on other types of machine tools may, by a slight modification in the design of the piece, be performed equally well by the use of the power press at a decided saving in the cost of material, labor, and overhead.

Influence of Welding on the Range of Press Work

Mention of a machine constructed for use in the manufacture of rear axle housings brings to mind the influence of welding upon the range of work for which the power press is adapted. The development of electric and acetylene welding methods has enabled these processes to be employed in conjunction with the power press, for the economical manufacture of many parts that could not be produced in single pieces. As a case in point, consider rear axle housings for motor cars. It is common practice to draw these parts up in two pieces, and then to weld the two halves together in order to give the desired result. Mechanically operated torches are often used to good advantage, as they not only give more uniform results, but also handle the work with greater rapidity than would be possible if the torch were manipulated by hand.

Development of Dies

An investigation of what is actually being accomplished will reveal the fact that there seems to be practically no limit to the complexity of work that can be performed, if the problem of designing suitable dies for the purpose is submitted to an experienced and skillful diemaker. Many parts are now being made in dies, which were formerly made at a greater cost by other methods; and the design of these tools is even more varied than that of the power presses by which they are operated. The extreme range extends from the simple blanking die ring and punch up to the automatic follow-die, which takes ribbon stock and performs a sequence of operations on it, each of which brings the work one step nearer to completion, until it is finally stamped out or cut off. These dies are made

with a number of stations under which the work is stopped as it progresses through the die, so that at each downward stroke of the ram one piece is operated upon at each station of the die, and one finished part is produced by each downward stroke of the press ram.

Drawing Roller Bearing Raceways

It has already been stated that one of the chief advantages to be secured by using power presses is the saving of labor and material. As a case in point, consider the work involved in the manufacture of sleeves for the outer raceways of a well-known type of roller bearing. These parts were formerly made from bar steel, worked in a screw machine which bored out the inside and turned the outside of the sleeve, preparatory to cutting it off the bar. The exact percentage of a solid bar of steel that is lost in the form of scrap produced in the making of sleeves by this method would naturally vary according to the diameter and thickness of different sleeves, but it would be safe to say that the average loss of material would be in the neighborhood of 80 per cent. The wages paid to a screw machine operator would also place quite a heavy labor charge against the job.

With a view to reducing the percentage of raw material converted into scrap, a change was made in the method of manufacture by substituting steel tubing for solid bars. The tubes were worked on a screw machine in exactly the same way as solid bars and it was still found necessary to bore the inside diameter and turn the outside of each sleeve before cutting it off. This improvement in the method of manufacture resulted in a substantial saving in the amount of steel that was scrapped, but the labor cost still remained about the same. Recently, a further noteworthy advance has been effected in the making of these parts. It consists of using dies for drawing the sleeves up from cold-rolled flat strip steel. By this method of manufacture, a deep shell is first drawn, and then this shell has the ends cut off, thus bringing the sleeve to the proper length. The dies have been developed in such a way that there is assurance of keeping the inside diameter and the thickness of every sleeve within the required limits, without resorting to subsequent machine work. Sleeves can be produced in these dies at a far lower cost than when the work was turned and bored on a screw machine, and the amount of material that goes to the scrap pile is not excessive.

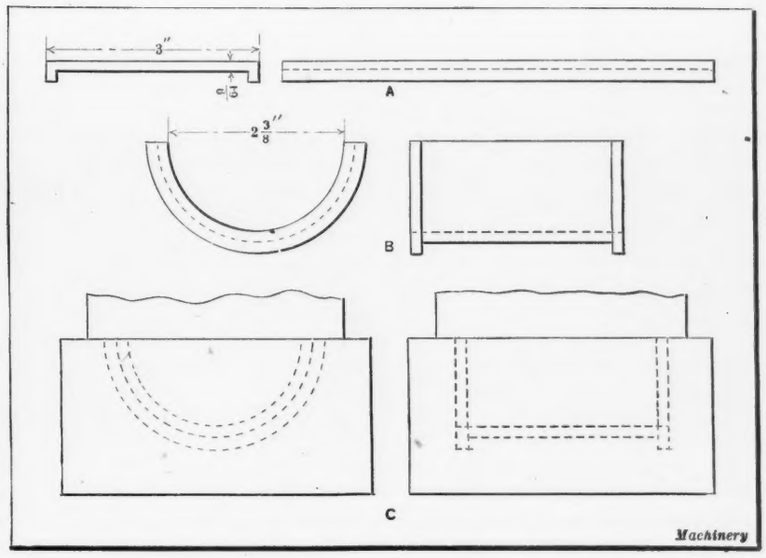


Fig. 1. Diagrams showing Successive Operations in forming Flanged Bronze Bushings

It is of interest to note that in order to obtain satisfactory results in the making of roller bearing raceway sleeves by this method, it is important to use cold-rolled steel of a perfectly uniform thickness. The material is purchased from the steel mill under specifications covering this point, and as it is delivered to the plant, the first step is to subject each strip of steel to a gaging process, in order to ascertain that its thickness comes within the required limits. This is done by passing the strips through an electrically operated gaging machine, equipped with contact points which touch opposite sides of the strip of steel. Any variation in thickness exceeding the specified limits is at once revealed by this machine, and all strips of steel that fail to pass inspection are rejected.

Last but not least among the general considerations involved in the substitution of press work for other methods of manufacture, on such classes of work as this, comes the important fact that, where automatic dies are used in the manufacture of small metal products, the material is fed to the die in the form of ribbon stock. After a machine is set up, it is only necessary for the operator to pay general attention to it. As a result, one man is able to look after about eight machines. This effects a substantial reduction of the labor cost as compared with cases where one operator is required for each machine.

Making Flanged Bronze Bushings

Fig. 1 shows successive steps in the production of bronze bushings which are made in halves and flanged at both ends. These pieces were formerly machined from castings, involving the usual steps of making molds, melting and pouring the metal, cleaning the castings, and machining

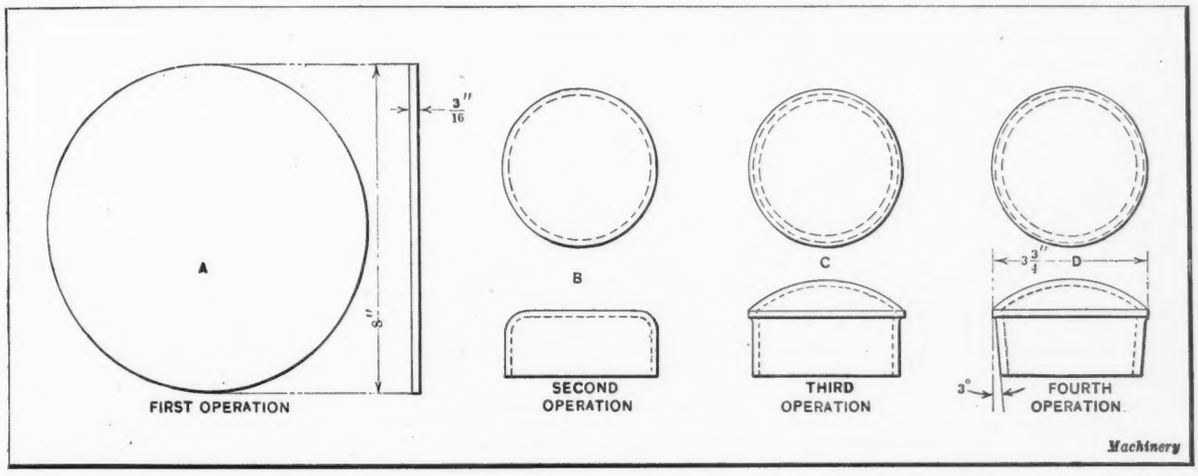


Fig. 2. Steps in the Production of Hand-hole Plugs for Boilers or Petroleum Stills

them. As compared with this procedure, the bushings are now completed, ready for assembly into the machine, by three power press operations. For making this product, strip metal is brought from the brass mill already flanged at each edge. The first operation consists of cutting off blanks *A* to the proper length. This is done on a No. 3 Stiles press. The second operation is performed in a 100-ton Bliss press, and consists of forming the blank to a U-shape, as shown by diagram *B*. Finally, the work, which has now been brought to approximately the required form, is finished in a 600-ton knuckle-joint embossing or coining press, equipped with a punch and die in which the metal is completely enclosed, so that it may be squeezed to the required shape and finish.

Bushings produced in this way do not require any subsequent machine work. Important among the advantages of making them under the power press are that there is a saving of material amounting to approximately 10 per cent of the total cost, while the rate of production under the press is about thirty times as high as that attained by the molding and machining of castings. For the first operation, blanks *A* can be cut off at twice the speed at which the second and third operations can be performed. Hence, the press used for cutting off blanks is only run half the time. Working on this basis, 2400 half bushings can easily be produced in an eight-hour day.

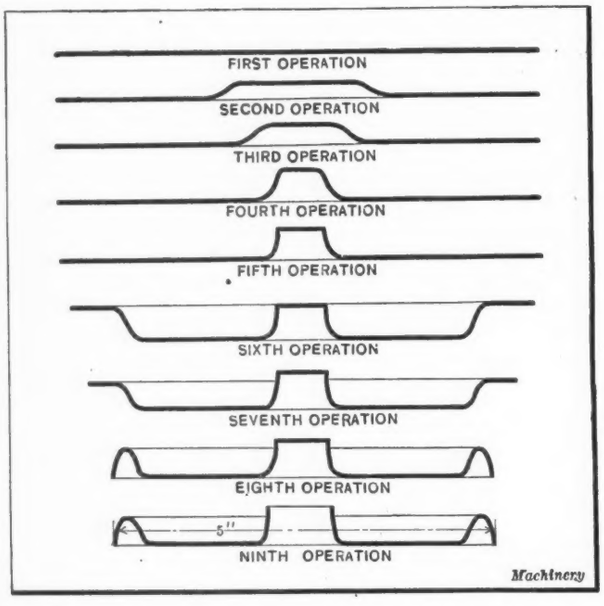


Fig. 3. Successive Steps in producing Half of a Pressed-steel Caster Wheel

Making Conical Shaped Hand-hole Plugs

In the design of some types of stills used for the fractional distillation of crude petroleum, and also in some types of boilers, there is use for a number of plugs of the form shown in Fig. 2. They are pushed into hand-holes which give access to the tubes in the still or boiler, and the pressure from the inside forces each tapered plug into its seat, so that complete sealing of the holes is insured by the pressure applied to the rear of the plugs. When it is desired to have access to the tubes, it is merely necessary to drive the plugs out of their holes. Plugs of this kind are made in various sizes, but the method of procedure in manufacturing is the same in all cases. Before it was shown that this was a job that could be economically handled on the power press, the method of procedure was to make steel castings and then to turn the 3-degree taper on a lathe equipped with the usual attachment for handling such work.

Under the present method of making them, four power press operations are involved. The first step is to cut a blank *A*, 8 inches in diameter, on a No. 5 Bliss-Stiles press. The second step is to draw a straight cup *B* on a No. 76½ Bliss power press equipped with a double die, so that two cups can be drawn at a time. Reference to diagram *C* will make it apparent that there is a small ridge formed on the outside at the closed end of the cup, which forms a shoulder that engages the hole into which the plug is driven. This ridge or shoulder is formed in a coining press, which squeezes the metal in such a way that it is extruded outward to fill an annular groove in the die. Finally, a fourth press operation is performed to produce the 3-degree taper on the outside of the shell; and at the bottom of the punch there are embossed letters which come into contact with the inside of the cup at the bottom and press the trademark into the work. On this job, it is estimated that the power press gives a production over ten times as great as that attainable in making steel castings and machining them in accordance with the method which has been briefly described. By making the plugs under the power press, an operator is able to produce 2000 plugs in an eight-hour day.

Making Caster Wheels from Sheet Metal

Until recently, it has been general practice to make various forms of caster wheels of cast iron or hard wood.

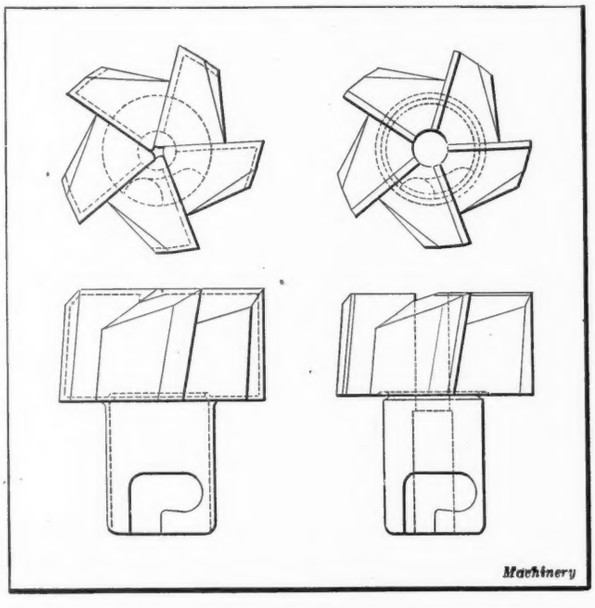


Fig. 4. End-mill Forging, produced on the Power Press within 1/16 Inch of Required Size

Both methods are likely to prove unsatisfactory, as either gray iron or wood is likely to break under heavy pressure or shock, and the cost of making caster wheels from these materials is high. Dies and methods have therefore been developed for making casters of various sizes and styles under the power press. These methods vary according to the size of the caster, but, in general, they are quite similar.

Fig. 3 shows the procedure in making a 5-inch caster wheel, two of the finished blanks of the form shown being riveted together to form this product. A study of the diagrams will make the sequence of operations quite clear. The first operation consists of stamping out the blank. Next come four drawing operations which bring the hub of the wheel successively to the conditions shown. The sixth is a so-called "dishing" operation, which raises the edge of the blank; this is the first step in forming the rim of the wheel. In the seventh operation, the edge of the blank is trimmed off. Next, the edge of the blank is turned down to complete forming the rim of the wheel. Finally, a ninth operation pierces the four rivet holes and also punches out the end of the hub. The advantages of a sheet-metal caster wheel of this kind are that its weight is one-third of that of a cast-iron wheel of the same strength, and the material costs only about one-quarter as much as cast iron. The

labor charge involved in making a steel wheel is about one-third the cost of molding, casting, and machining wheels from wood or cast iron. On this basis, it is estimated that the cost of making wheels from sheet steel is about 29 per cent of the cost of iron wheels; and the steel wheels are superior on the basis of strength and durability. All the operations are performed on Bliss No. 20 power presses, with the exception of the ninth operation, which can be done on a No. 19 or a No. 18 press. The rate of output is 4800 blanks per day; and two operators can assemble 300 casters in eight hours.

Forging under the Power Press

Power presses are now finding application for the performance of certain hot-forging operations that were formerly done exclusively under drop-hammers. In some cases, this work has been developed along lines which provide for holding the dimensions of the forging within extremely close limits, so that the cost of performing machining operations is substantially reduced. Also, this is the means of effecting a substantial saving in material, which is especially important when a high-priced steel or other metal is being forged. Another advantage claimed for the pressing operation is that a refinement of the grain of the material is obtained by squeezing it while hot.

As an example of work of this kind, consider the forging of tool-steel blanks for end-mills, as shown in Fig. 4. This is done on a Bliss No. 75½ geared press which is capable of developing 100 tons pressure. The blank is forged within 1/16 inch of the desired size on all surfaces, and an experienced operator is able to produce 1200 forgings in an eight-hour day. It will be evident that with a forging having only 1/16 inch surplus metal on all surfaces, instead of a cylindrical blank cut from a tool-steel bar, the cost of producing a cutter will be greatly reduced. Of course, the exact ratio will vary according to the steel being handled, the size and form of the cutter, and other similar conditions.

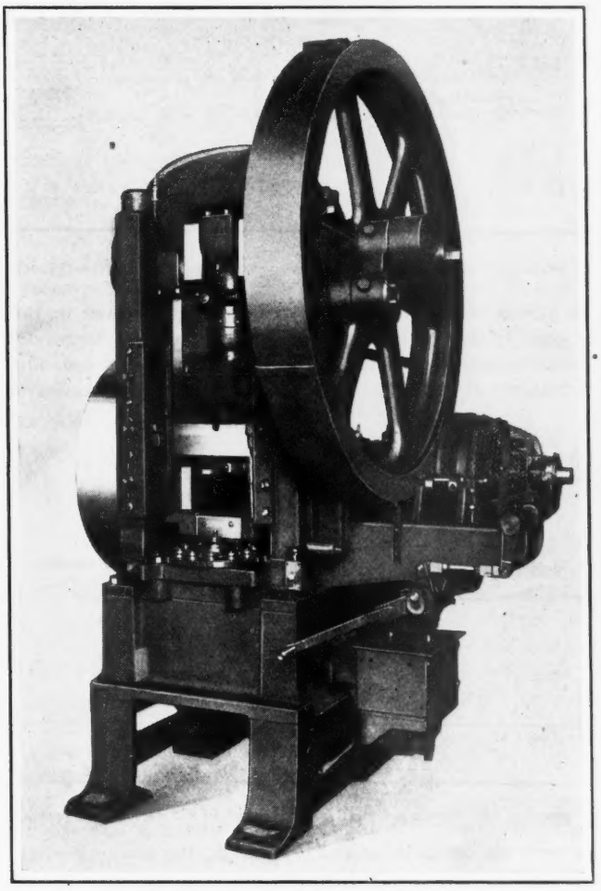


Fig. 5. Power Press with Dial Feed equipped for Broaching Operations on Bronze Bushings

Use of the Power Press for Broaching

Where broaching operations are to be performed on pieces of such a form that the broach need not be of considerable length, the power press may be utilized to advantage. The broach is pushed through the work instead of being pulled through as on a regular broaching machine. The chief advantage of the power press lies in the fact that for many classes of work it is possible to utilize a dial feed mechanism, thus greatly increasing the production.

Fig. 5 shows a Bliss press equipped for broaching bronze bushings 1 inch in diameter by 2 inches long. The press is run continuously, and the operator is merely required to take the cast blanks from the container in which they are delivered to the machine, and drop them into successive pockets of the dial. The dial carries the work around under a broach, which is stepped in such a way that the beginning of the broach roughs the outside diameter while the final teeth complete the broaching operation. The dial then carries the work around to a point where it is brought under a knock-out located above a chute under the hole in the dial. As the finished bushing is knocked out of the dial, it falls down the chute into a container beneath. On this job the rate of production is 18,000 broached bushings in an eight-hour day.

Making Pressed-steel Connecting-rods

It cannot be said that pressed-steel connecting-rods are at present finding application as a substitute for machined forgings; but the possibilities of extending the range of the power press to cover this field, in order to take advantage of the economies that may be effected through the rapidity with which the work could be handled, are shown in Fig. 6. This illustration shows the steps in making connecting-rods from pressed steel. The body of the rod is made in halves, and the cap is produced in a single piece. Each of these parts is made under the press by three operations. After blanking, the body or cap is completely formed by the second operation, with the exception of trimming, which is done separately. It is not the intention to make comparisons between the relative merits of rods produced in accordance with standard practice and by this means of manufacture. However, there is no doubt that in so far as rates of production are concerned, the pressed steel parts can be produced at a much lower cost.

Forging Ends of Connecting-rod Bearings

When connecting-rod blanks are made from forgings, the usual procedure is to bore and face the holes for the crankpin and wrist-pin bearings. A variation from this procedure which reduces production costs, has recently been developed. It consists of performing a cold-forging operation on the blanks to make the bearing faces uniform, without the necessity of facing. By handling this work under the power press, it can be done at a lower cost. A press equipped for this operation has dies of the form shown in Fig. 8, with flat upper and lower members which engage the two sides of the crankpin or wrist-pin bearings on two forgings, the one to the right only being shown in place; at the center of the dies there are two buttons over which the previously bored hole at the opposite end of the work is dropped, prior to swinging each blank into place for the cold-forging operation. On this job the rate of production is 6000 rods in an eight-hour working day.

Cold-forging Parts of Instrument Mechanisms

In Fig. 9 are shown three examples of the successive steps in blanking and cold-forging parts of instrument mechanisms under the punch press, and a study of these examples will reveal the economies that are effected through the adoption of this method of manufacture. Obviously, there is no comparison between the cost of making these parts on the press, and turning blanks and then generating the teeth by

hobbing or some other method. The dies in which this work is done are made with a sufficient degree of accuracy so that these instrument parts will possess the required degree of precision.

Little description is required to make the successive operations clear. In each case, there is a preliminary blanking operation, and this blank is worked through successive dies, until the work reaches the desired form. It is interesting to note in this connection the provision that has been made for producing the irregular forms. Take the case of the gear for which the sequence of operations is shown at the top of Fig. 9. To provide for forming the small dog on the hub of this gear, it will be seen that one tooth of the preliminary blank is made considerably larger than the rest, so that sufficient metal is left to give the desired formation. This principle is often employed and is one that will be found useful in handling many jobs of this kind. Formerly, composite parts of this kind had to be made in two separate pieces and riveted together. As compared with such a procedure, the economy of doing the job on the power press will be obvious.

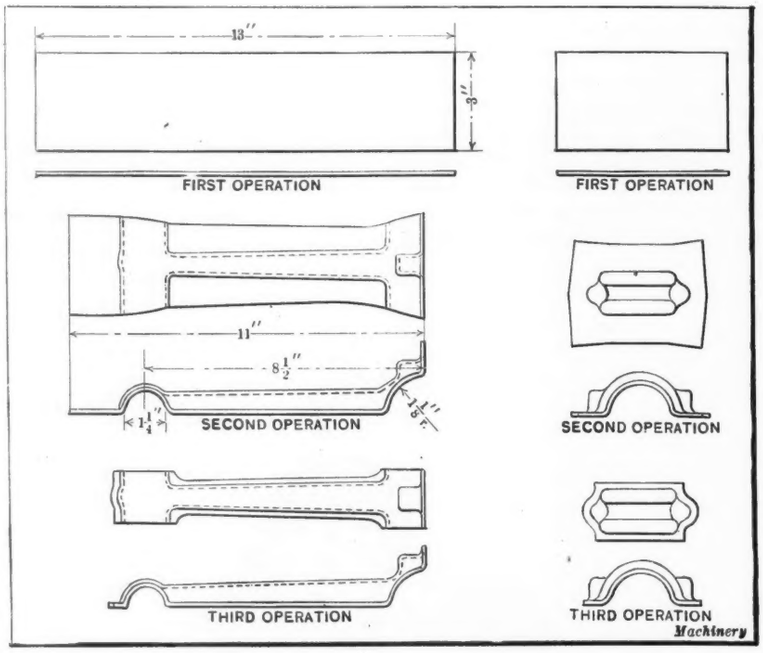


Fig. 6. Successive Steps in the Manufacture of Connecting-rods from Pressed Steel

Making "Whistler" Valve Cams

In the "Whistler" motor car tire valves made by the Automatic Products Corporation, Long Island City, N. Y., provision is made for setting the valve to hold a given air pressure. When this point is exceeded, the tire begins to blow off, and this is indicated by the whistling of the valve. Provision is made for setting the valve to hold 50, 60, 70, 80, or 90 pounds by means of a graduated cam of the form shown in Fig. 10. These cams were formerly made from brass tubing worked on an automatic screw machine, which graduated the cam with a rolling tool carried on the rear cross-slide and cut it off with a parting tool at the front of the machine. Then the pieces went to a special profile milling machine which cut the edge of the cam to the required contour. The production time was about seven seconds for the two operations, giving an output of 3840 per eight-hour day.

The preceding method of production was not entirely satisfactory, and the problem of making these parts under the power press was submitted to the Nelson Tool Co., of New York City. This concern developed dies for doing the work in two operations, as indicated in Fig. 10, and is now manufacturing these parts for the Automatic Products Corporation. At the first operation, the piece is blanked and graduated; and the blanks produced in this way then go to a curling die which folds them to the finished form, as indicated by the diagram for the second operation. It will be noted that the ends of the blanks are dovetailed, so that after they have been curled they are locked together. By the use of the power press on this job, the high rate of production of 32,000 cams per eight-hour day was attained.

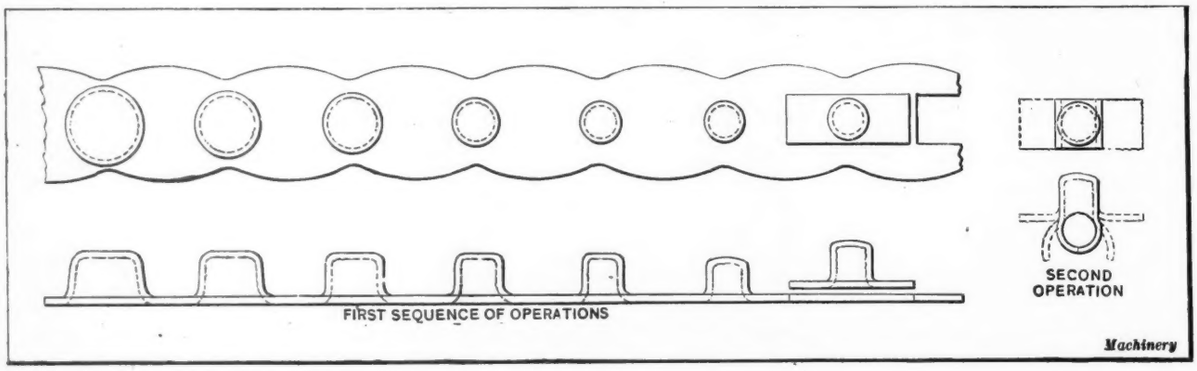


Fig. 7. Sequence of Drawing and Blanking Operations performed in a Follow-die to produce a Cam Pin Blank

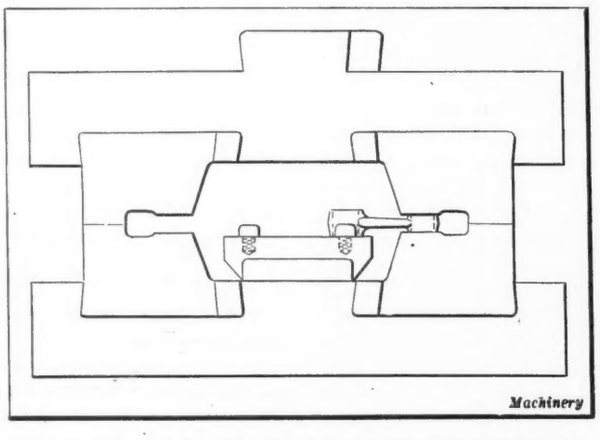


Fig. 8. Dies used for cold-forging Ends of Connecting-rod Bearings, instead of facing the Surfaces

Procedure Followed in Making Cam Pins

At the right-hand side of Fig. 7 is shown the cam pin which runs in contact with the cam of the "Whistler" valve. Formerly these pins were made from square brass bars worked in an automatic screw machine, and when handled in this manner the method of procedure was to

turn the round trunnion and then cut off the blank in such a way that a square block was left behind the trunnion. In this condition, the work was sent to a special drilling fixture, which was provided for drilling a hole through the square block. Handled in this manner, the total time for the two operations was about five seconds, making the production 5760 per eight-hour day.

This problem was also taken over by the Nelson Tool Co. The method of procedure finally worked out consists of running brass ribbon stock through a follow-die, which performs six successive drawing operations, and then shears out the blank as indicated by the diagram for the first sequence of operations. The blanks produced in this manner are then sent to a curling die which rolls up the flat ears at each side of the shell that forms the cam trunnion, to produce the bearing that was formerly made for drilling a hole through the square block. On this operation, the rate of output is 500 cam pins per hour for the two operations, making the daily production 4000 in eight hours.

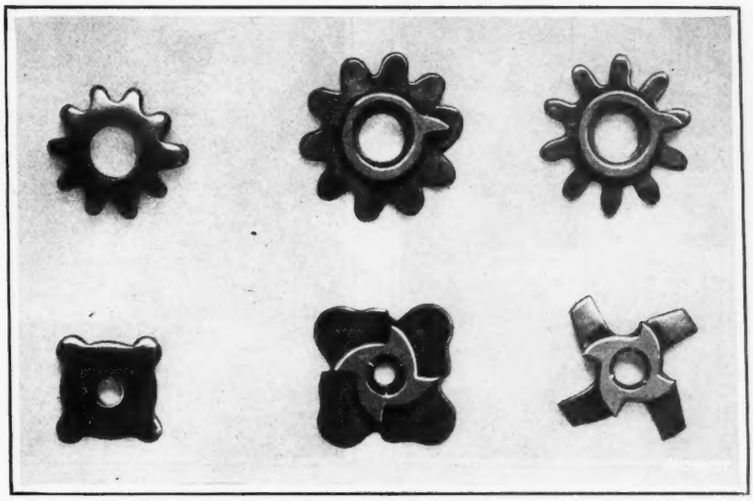


Fig. 9. Successive Steps in blanking and cold-forging Two Instrument Parts

* * *

REMOVING DENTS FROM METALLIC SHELLS

By FRANK E. CHACE

In manufacturing articles in the form of thin metallic shells or tubing, great care in handling is required to prevent denting the surface of the work. Even when special care is taken, dents are often made, and the loss from this cause may be considerable, especially if the material is expensive or the work near completion. Therefore, attempts are often made to repair such work in order to make it salable. The methods described in the following for removing dents from metallic shells are interesting, because they are out of the ordinary and are not met with in regular lines of manufacture.

If the shell has an opening at one side, large enough to permit a suitable tool to enter, the dent can sometimes be removed by placing the end of the tool on the bent-in portion and driving outward. If the work to be repaired is a cylindrical tube, a sizing plug may be entered to force the metal outward. If the shell is thin and spherical in shape, with an opening small enough to be plugged, it may sometimes be repaired by first filling with water and then plugging the hole, and lightly tapping the outer edge of the dent with a wooden mallet. By keeping the opening tightly sealed, and allowing no air space in the shell, the blows struck with the mallet will compress the liquid and force the center of the depressed metal outward. This method of procedure, of course, is applicable only when thin metal is being handled.

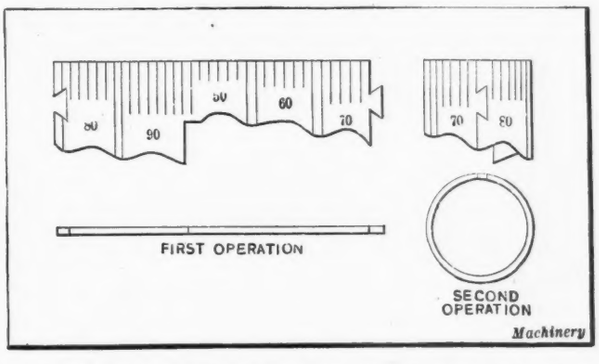


Fig. 10. Blank and Finished Cam for a "Whistler" Tire Valve, produced in Two Operations under the Power Press

The following is a method of forcing out a dent in a shell having a small mouth or opening. This method utilizes the expansive properties of melting rosin. The first step is to fill the shell with melted rosin. As the rosin cools it contracts greatly, and while it is cooling and contracting, more rosin is added so that when it is thoroughly cooled the rosin entirely fills the interior of the shell. When entirely cooled, a hot flame from a blow-torch is applied directly on the depression which it is desired to lift. The rosin beneath the depression will soften and expand, thus lifting the metal upward. Care must be used to apply the heat quickly to the proper spot and keep the other parts cool. The pent-up forces are tremendous, however, and if too much heat is applied, an accident may result.

If there is no means of working from within a shell, a wire nail having a large head may be soft-soldered by its head to the surface of the depression. This nail can then be grasped with vise jaws or strong pincers and the metal pulled outward. Still another method of eliminating dents that can sometimes be used to good advantage is to grip at one end, in a bench vise, a round iron or steel rod, several feet long. The length of the rod must be in such proportion to its diameter that it will vibrate or spring vigorously when struck with a hammer. Too large or too short a rod will be too stiff. Too small or too long a rod will be too weak, and will therefore be bent. When the rod is struck a sharp downward tap or blow with a hammer, at a point near the middle, but on the side toward the vise, a vigorous upward "kick" is given by the free end.

A small portion of the free end should be bent at right angles to the rod, and when in position for use this short end should project upward. Two operators may be required to use this device. One operator inserts the rod end into the mouth or open side of the shell, resting the depressed spot upon and directly over the upward projection of the rod end. Another man strikes a sharp blow downward at a spot on the rod between its center and the end gripped by the vise. A vigorous "kick" results, and the metal is driven upward at the free end of the rod.

In some of these methods, when driving outward from within, the metal may of course be driven too far, but since the hump is then on the outside, it is an easy matter to tap it back into place with a mallet, or force it back by other means until the desired contour is produced. Filing or buffing and polishing will hide the lesser tool marks.

* * *

The first International Congress of Aerial Navigation will be held in Paris, November 15 to 26. All correspondence relating to this congress should be addressed to the Secrétaire Général du Congrés International de la Navigation Aérienne, 9, rue Anatole de la Forge, Paris 17, France.

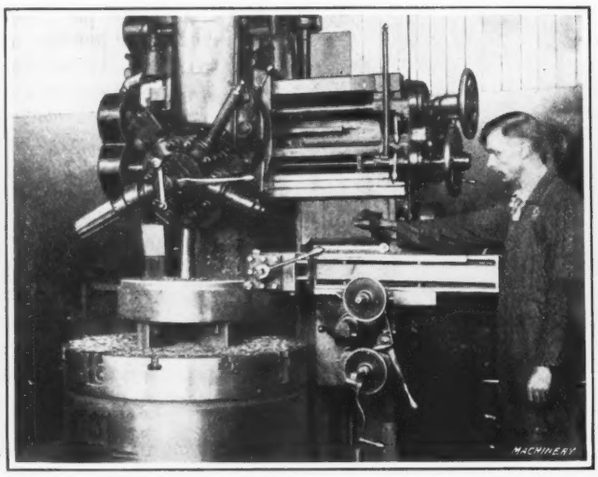


Fig. 1. Rough-boring and turning the Outside Diameter of a Locomotive Piston-head

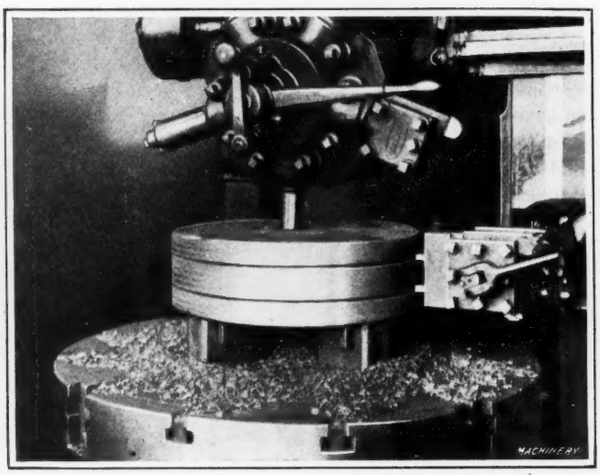


Fig. 2. Piston-ring Groove Turning Operation, in which Two Tools are used in the Side-head Turret

Production Work in the Locomotive Shop

Application of the Bullard Vertical Turret Lathe to Locomotive Shop Practice, with Typical Examples and a Description of the Tooling for Each Job—First of Two Articles

The high cost of production in railroad shops has been the subject of many comments in both the daily and the technical press, in public speeches, and in governmental reports. Costs can be reduced in railroad shops in three ways—by capable management; by the efficiency of labor; and by the employment of labor-saving and cost-reducing machines and methods. The present article deals with the last phase, and shows a number of examples of economical production by the use of the vertical turret lathe in combination with carefully laid out tooling equipments.

THE machining of piston-heads and piston-rings is a common job in the locomotive machine shop. The piston-head machining lay-out shown in Fig. 3 is a typical one for this class of work. It will be seen that this piston-head has a tapered hole for the piston-rod, so that in machining it, a method is involved which is commonly employed when tapered holes are finished on the Bullard vertical turret lathe. Also, it will be seen that this hole is counterbored on the under side, and that special means have been provided in chucking the work to enable this recess to be machined without the necessity of rechucking it. The piston-head is machined complete in five operations, and is chucked by employing special jaws *A* in which there is a stud that enters the hole on the under side of the work. This arrangement furnishes a positive drive, holds the work securely, and allows plenty of clearance space for the boring-bar that was used in the under-cutting operation, previously referred to.

Machining Operations on Piston-heads

In the first operation, a tool of special form is employed to face the raised surface surrounding the tapered hole and the remaining end surface of the piston-head. During this operation, the outside diameter is rough-turned by a tool carried in the side-head turret. The second operation is that of rough-boring the tapered

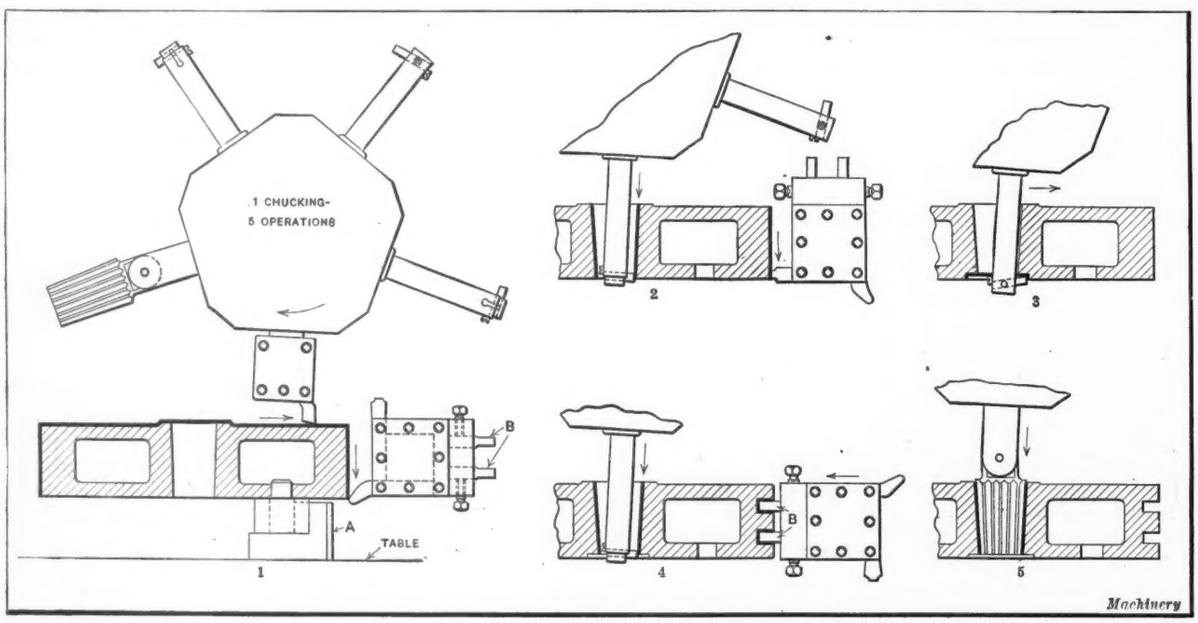


Fig. 3. Tooling Lay-out for a Locomotive Piston-head

hole while another tool in the side-head turret is finish-turning the diameter. It will be noticed that the main turret is set at an angle corresponding with that of the taper of the hole, and that the turret occupies this angular position throughout the sequence of machining operations.

In the third of the series of operations, the under-cut on the lower side of the piston is machined as indicated in the tooling lay-out, using a boring-bar in the main turret. The next operation is that of truing up the tapered hole, and for this a separate boring-bar is employed. During the truing cut, two tools *B*, carried in a special tool-holder attached to the side-head turret, are engaged in machining the piston-ring grooves.

For the final operation, a floating reamer peculiar to this type of machine is employed. This floating or hinged reamer hangs vertically downward from the shank to which it is pinned, and by its use the resetting of the main turret, which would be required with an ordinary reamer, is unnecessary. In this operation, the previously bored hole is finished. This piston-head is 23 inches in diameter, and the machining time required to complete the series of operations is forty-eight minutes per piston-head, including chucking work.

Figs. 1 and 2 illustrate two of the machining operations on the piston-head. In Fig. 1 the outside of the piston is being rough-turned, while Fig. 2 shows the fourth operation, in which the piston-ring grooves are machined, and the central hole is trued up, simultaneously. These illustrations also show how the work has been raised by the use of special chucking jaws. There is one other detail in the tooling arrangement which might be of interest; that is, the use of a tool in every face of the turret, rather than the use of combination tools, such as a special multi-cutter, boring-bars, and tool-holders, which are often used when conditions require it. In this case, however, the use of a separate bar in each station is an advantage in that the tur-

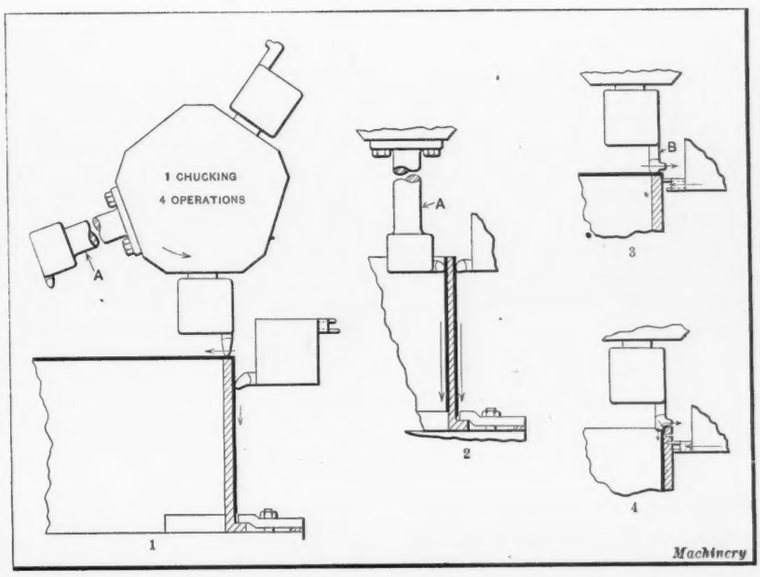


Fig. 4. Sequence of Operations and Tooling Arrangement for producing Piston-rings from a Pot Casting

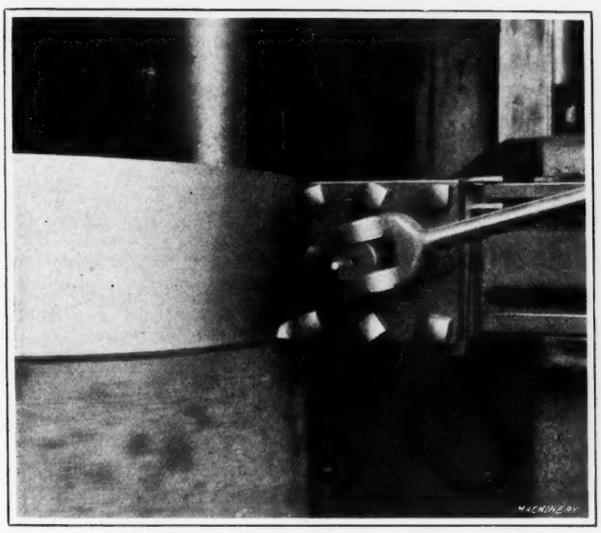


Fig. 5. Close-up View of the Second Operation in machining the Piston-ring Casting illustrated diagrammatically in Fig. 4

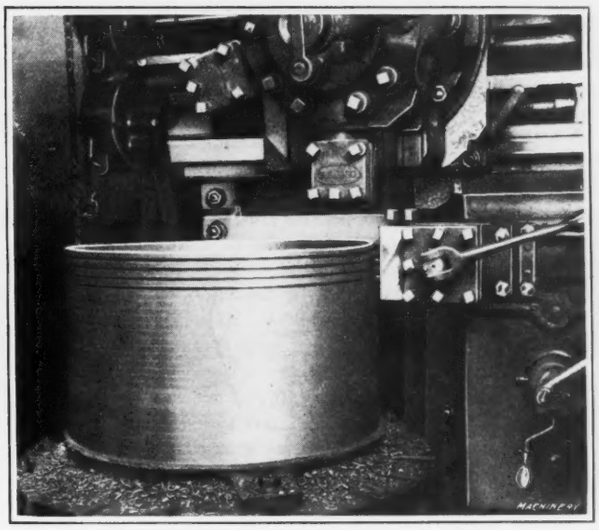


Fig. 6. Using the Set-up illustrated in Fig. 7 for cutting off Piston-rings with a Gang of Parting Tools

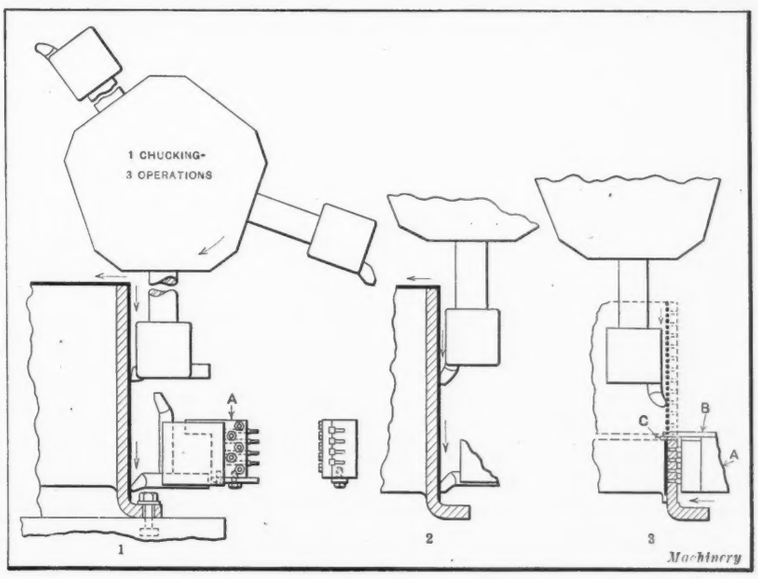


Fig. 7. Tooling Arrangement in which the Piston-rings are cut off with Multiple Tools carried in a Special Holder in the Side-head Turret

ret is thus better balanced. This piston job is fairly representative of work of this kind, and should enable a good idea to be obtained of the adaptability of the vertical type of turret lathe for finishing locomotive piston-heads.

Machining Piston-rings

The machining of piston-rings is a job which may be tooled up in a variety of ways, according to the conception of the set-up man for obtaining the best results. Fig. 4 illustrates one tooling arrangement used. In this instance, the pot casting from which the piston-rings are produced is clamped by suitable straps and jaws to the machine table, and is machined in four operations as follows:

The end of the casting is first rough-faced, and the exterior rough-turned; in the second operation, the tool carried in the extension tool-holder *A* rough-machines the inside of the casting while the exterior is being finish-turned by a tool carried in the side-head turret. A special tool *B* is employed in the third operation, first to finish-face the end of the casting, and then to break down the interior edge. The same tool is employed in the fourth operation, in which the casting is finish-bored. While the finish-boring operation is in progress, two parting tools, carried in the side-head turret, are engaged in cutting off the rings. The parting tools are fed in to a sufficient depth so that as the finish-turning tool feeds down, the rings will be severed. By using only two parting tools, instead of a gang, as is sometimes done, a better job results, because the rings do not have to be faced after being cut off.

Fig. 5 is a close-up view showing the second operation on the piston-ring job. These pot castings are approximately 24 inches in diameter and 16 inches high. The table speed used in producing these rings was 7 revolutions per minute, and the feed 1/32 inch per revolution. The time required to machine this casting and cut up twenty-two completely finished piston-rings was six hours and fifteen minutes.

Another piston-ring job is shown in Fig. 7, and as the illustration shows, three operations complete the job. These piston-ring castings are cut up into sixteen complete finished rings, the tooling arrangement being somewhat different from that described in connection with Fig. 4. The exterior of the casting is rough- and finish-turned by using two tools simultaneously, one carried in the main turret and one in the side-head turret. These are clearly indicated in the first and second operations. The tool carried in the main turret, in each of these two operations, also machines the top of the casting, as indicated by the arrow. In the final operation, use is made of a gang of parting tools, carried in a multiple holder *A*. The proper vertical position of these multiple tools is obtained by the use of a parallel *B* and a size block *C*. It is necessary to employ this means of adjusting the parting tools after each feeding-in traverse of the tools has been completed. Fig. 6 is a view of the beginning of the cutting-off operation, and gives an excellent idea of the appearance of the work and the tools. The time required to produce these sixteen rings is from two to two and one-half hours.

Machining Locomotive Cylinder Heads

A job on which the vertical turret lathe is used to good advantage is that of finishing locomotive cylinder heads. In the illustration Fig. 8, a complete tooling lay-out is shown of both chuckings required to finish this casting. Special sawtooth jaws, by means of which the work is chucked in the first setting, prevent the cylinder head from lifting from its seat on the locating buttons on which it rests.

The first operation of the first chucking is shown in Fig. 9, as well as the complete turret tooling employed. This

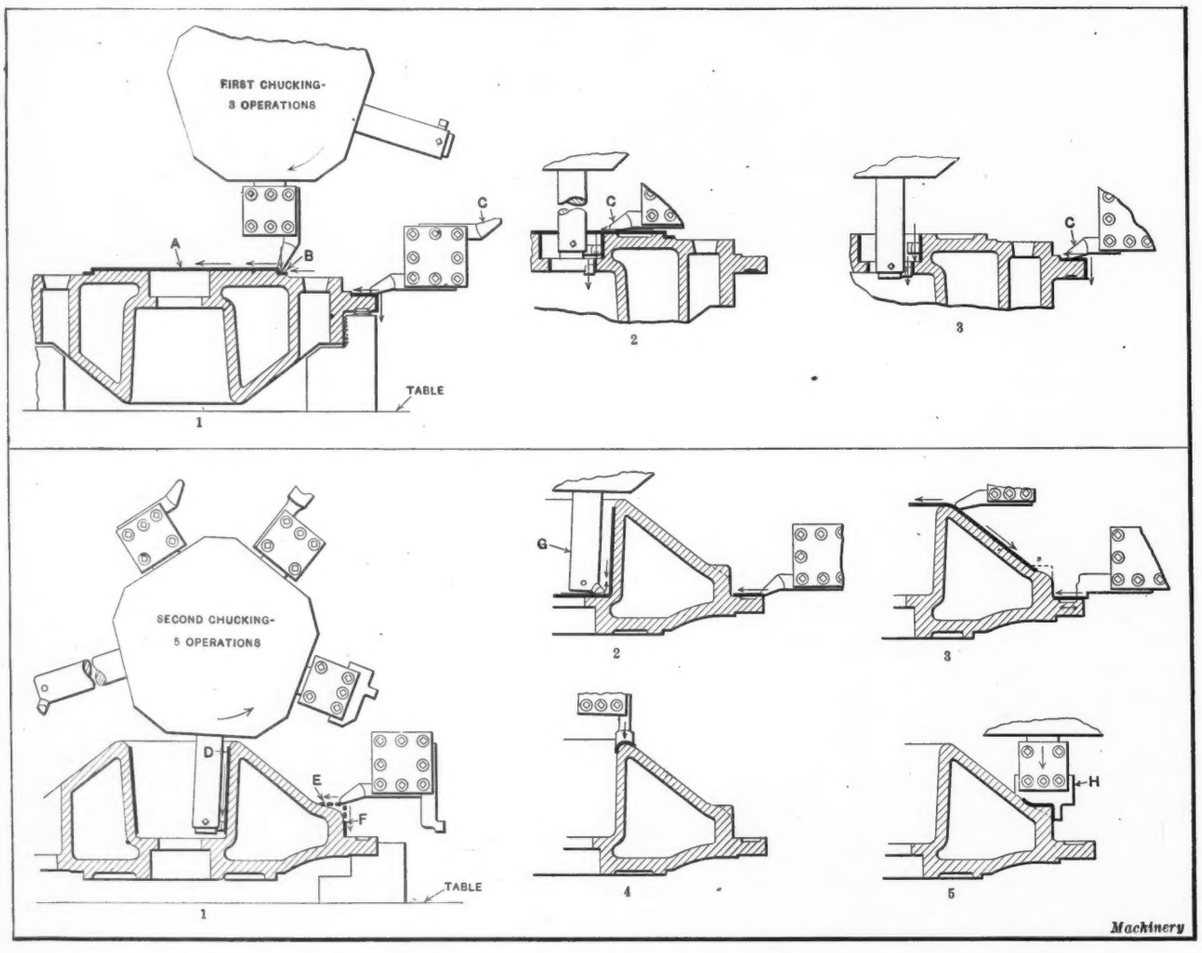


Fig. 8. Tooling Arrangement used in the Two Machine Set-ups shown in Figs. 9 and 10 for machining a Locomotive Cylinder Head

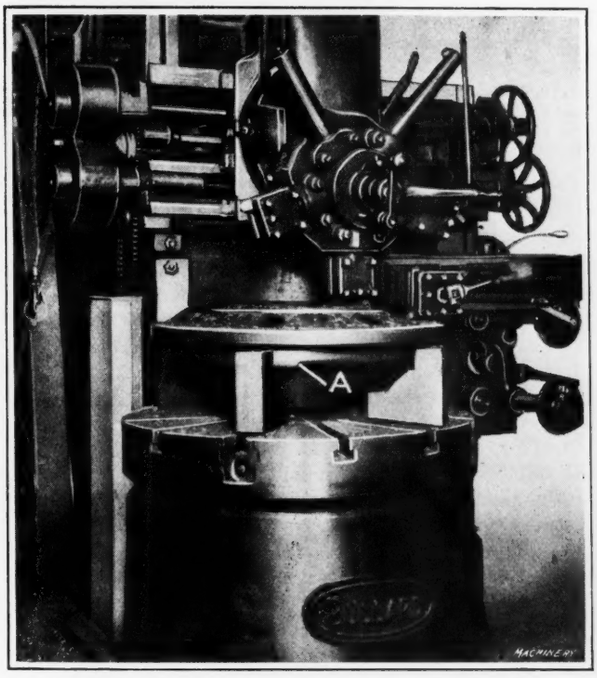


Fig. 9. First Operation on the Locomotive Cylinder Head

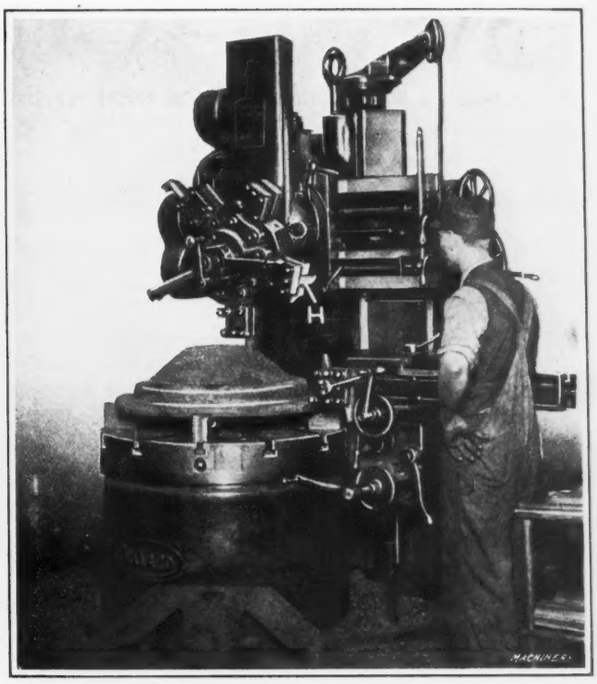


Fig. 10. Fourth Operation on Opposite Side of Cylinder Head

operation consists of rough-facing surfaces *A* and *B*, Fig. 8, and rough-turning the shoulder connecting these two surfaces with a tool carried in the main turret tool-holder, and rough-facing and rough-turning the flange with a tool in the side-head turret. In the second operation, surfaces *A* and *B* and the connecting shoulder are finished with tool *C* in the side-head turret; at the same time the special boring-bar carried in the main turret is employed to rough-bore the two diameters of the central hole, as indicated by the arrows. The last operation in the first chucking finishes the central hole in the work, a finishing cutter being substituted for the roughing cutter, while the flange is simultaneously finish-faced and turned, still using tool *C* in the side-head turret.

In the second chucking, there are five machining operations on the other side of the cylinder head, as shown, the first of which is the rough-boring of hole *D* while surfaces *E* and *F* are rough-turned with the side-head turret tool. The central hole is next finish-turned and cleaned up on the bottom with a special tool carried in the boring-bar *G*. While this tool is in operation, the upper surface of the flange is rough-faced with a side-head turret tool, as shown. In the third operation, both turrets are simultaneously engaged to machine the angular exterior surface of the cylinder head and to finish-face the flange. The fourth operation is that of forming the radius connecting the hole and the angular exterior surface, using a special formed turning tool in the main turret tool-holder. As indicated by the dotted line in the sectional view of the work shown in the diagram of the first operation in the second chucking lay-out, and as also clearly shown at *A*, Fig. 9, there is a built-up section or lug, extending about two-thirds around the circumference at the lower part of the angular surface, which must be machined. In the last operation on the cylinder head, a special form cutter *H* (shown also in Fig. 10) is required to finish this lug and cause it to blend nicely with the adjacent surfaces. This completes the machining of the cylinder head, the approximate diameter of which is 36 inches. The production time on this job is four hours—one hour for the first chucking, and three hours for the second.

In the second and concluding installment of this article the tooling up for machining cross-heads and main throttle valves will be dealt with.

CONVENTION OF THE SOCIETY FOR STEEL TREATING

At the convention of the American Society for Steel Treating held in Indianapolis September 19 to 24, a great number of papers relating to all phases of steel treating were read. The papers were grouped under special sections covering tool steel, metallographic research, heat-treatment of steel, carburizing, management, alloy steel, properties of carbon and alloy steels, heat-treating equipment, and furnaces. Under the heading of tool steel the papers read dealt with tool steel specifications; forged high-speed milling cutters; physical tests on high-speed steel; providing properly rolled tool steel for the steel treater; tool steel manipulation; heat-treatment and uses of high-speed steel; a comparison of American and English methods of producing high-grade crucible steels; and the effect of tungsten content on the specific gravity of high-speed steel. The papers on the heat-treatment of steel dealt with modern methods of heat-treating; the efficiency of annealing overstrained steel; coarse-grained forgings, their detection and correction; the problem of the influence of mass on heat-treatment; the whys of warping; malleable iron; theory of hardening steel; tests showing the effect of high temperatures on malleable iron; a coiling and heat-treating plant for helical springs; fracture test on steel to determine its quality; and "Dow-metal," and its application. A complete list of all the papers and copies of such papers as may be desired may be obtained from the secretary of the American Society for Steel Treating, 4600 Prospect Ave., Cleveland, Ohio.

The following officers were elected for the coming year: F. P. Gilligan, president; F. C. Lau, first vice-president; R. J. Allen, second vice-president; and J. V. Emmons, treasurer. A. E. White, the retiring president, was elected a member of the board of directors, as was also J. J. Crowe. During the year just passed the society has had a satisfactory growth. Today the membership is 3200, a substantial increase over a year ago.

OCTOBER, 1921

MACHINERY

VOL. 28 NO. 2

PUBLISHED MONTHLY BY THE INDUSTRIAL PRESS, 140-148 LAFAYETTE ST., NEW YORK

ALEXANDER LUCHARS, PRESIDENT
MATTHEW J. O'NEILL, GENERAL MANAGER
ROBERT B. LUCHARS, SECRETARY

LONDON: 52 CHANCERY LANE
PARIS: 121 RUE LAFAYETTE

ERIK OBERG, EDITOR
FRANKLIN D. JONES, ASSOCIATE EDITOR
EDWARD K. HAMMOND, WESTERN EDITOR

SAVINGS BY THE USE OF JIGS

In these days of interchangeable manufacture, when machines or parts are made in great quantities, jigs and fixtures are universally employed. In the machine tool industry where machines are built in smaller lots, special tools and fixtures are not always warranted, but they could be employed to a greater extent than is usual; and it has been shown in many cases that this would prove economical. The great expense of a complete tooling equipment acts as a deterrent, and many operations are performed year after year in a relatively wasteful way because of the fear of a large original outlay.

One machine tool builder has used the present slackness in business to make a thorough study of his manufacturing methods and to provide special tools, jigs and fixtures wherever it seemed profitable to do so. He has not hesitated to make the necessary investment, even during this period of depression. On one of his machines alone he has reduced the time required in the assembling department from 47 hours to 12 hours by making parts strictly interchangeable through the use of jigs and fixtures, and in addition the machining time has been reduced from 300 hours to 250 hours.

In this case there is a gain of 85 hours on each machine. Figuring at $1.50 an hour, including overhead, the total saving per machine is $127.50, which is a little more than 6 per cent interest on an investment of $2000. Assuming that 50 machines a year of this size were built, it will be seen that an investment of $100,000 might be warranted in jigs and fixtures, if an interest of 6⅜ per cent were considered sufficient and depreciation were not taken into account, as, of course, it would have to be. The tooling equipment for a single machine would seldom be as high as this, the figures being given merely to show that quite a large investment is warranted where an appreciable number of working hours can be saved on each machine.

It is necessary in each case to make an estimate of the number of machines likely to be built annually, the saving that can be effected by the use of jigs and fixtures, the cost of such equipment, and how soon it is likely to become obsolete, before going ahead with the design and building of special tools. It is true that serious mistakes have been made in overdoing special tooling equipments, and in every case a decision must be based on a careful consideration of all the factors involved. But no manufacturer can lose anything today by studying every detail of production in order to reduce costs.

* * *

IMPORTANCE OF SHOP TRANSPORTATION

The problem of transporting materials within the shop is more important than many executives realize. It is expensive to move heavy materials to and fro in a shop, particularly when they have to be lifted by elevators from one floor to another, or transported long distances either by hand or electric truck.

Any plant of appreciable size should be so laid out that the material can move in a continuous route from the receiving to the shipping department. If no consideration is given to the movement of material through the plant, it is likely that routes will gradually develop by which thousands of dollars will be lost annually for trucking and transporting expense. The executive of a large concern was recently asked to help in the reorganization of another plant employing about 3000 hands, and the first thing he called for was a blueprint of the whole lay-out of the plant on which was shown by a red line the route of an average part from the moment it entered the receiving room until it reached the shipping room as part of a completed machine. The blueprint he obtained showed that the part selected for the test had traveled 4½ miles during its course through the shop and crossed its own path forty times.

In another case it was found that in a five-story shop, certain castings went up and down the elevators twelve times, traveling three times from the basement to the top floor. By rearranging the machinery it was necessary to lift these castings by elevators only once from the basement to the top floor, from which they descended by gravity conveyors from floor to floor, as required.

A third example shows that the product of one plant was doubled without adding a single man to the force for trucking and moving materials, simply by systematizing the shop arrangement and the moving methods. In this plant it was found that one part moved nine times from one building to another before its completion.

In one large factory a distinction is made between short hauls and long hauls, and methods have been developed which meet the requirements in each case. For the short haul—that is, movements within the same department—casters are placed under the platform on which the material is moved, so that it can be rolled from one part of the floor to another. Electric trucks are used for the long hauls from one department or one building to another. These trucks are so arranged that platforms provided with casters as previously mentioned can slide directly on the truck, which, being electrically operated, is then quickly moved to its destination. A careful examination of the routes of material in your plant may develop some worthwhile economies.

* * *

UNNECESSARY LOSS OF POWER

To attain maximum economy in the operation of a shop or factory, it is of importance to maintain accurate alignment of the lineshaft bearings. Many manufacturers have their lineshaft bearings lined up at regular intervals, thereby keeping the friction load as low as possible; but this practice is not general, mainly because the amount of power wasted through inaccurate alignment of the bearings is not realized and because tests to show the actual loss are expensive and difficult to make.

In a few instances where such tests have been made, the value of periodically lining up the bearings has been conclusively proved. Needless to say, the alignment of lineshaft bearings should be undertaken only under the supervision of a man experienced in this kind of work. Whenever possible, the power required to drive the shafting under the friction load before and after re-alignment should be determined as accurately as possible. When bearings which are badly out of line have been re-aligned, it is found that the saving in power is quite considerable throughout the year. It is the attention to details like this that often makes it possible to show a favorable balance at the end of the year. It is not only the big savings that count, but the aggregate of the smaller economies; and power, after all, is not one of the minor items of the cost of running a manufacturing plant.

Reducing Production Costs

Through More Efficient Equipment and Methods

PRICES have come down on practically every article produced directly or indirectly by means of machine tools—from automobiles to lawn mowers. Costs must follow until a balance of costs and prices is reached. The tides that rise regardless of the marooned are not more certain or indifferent in their destructive power than this law of business which destroys those who are unable to adjust themselves to its reactions.

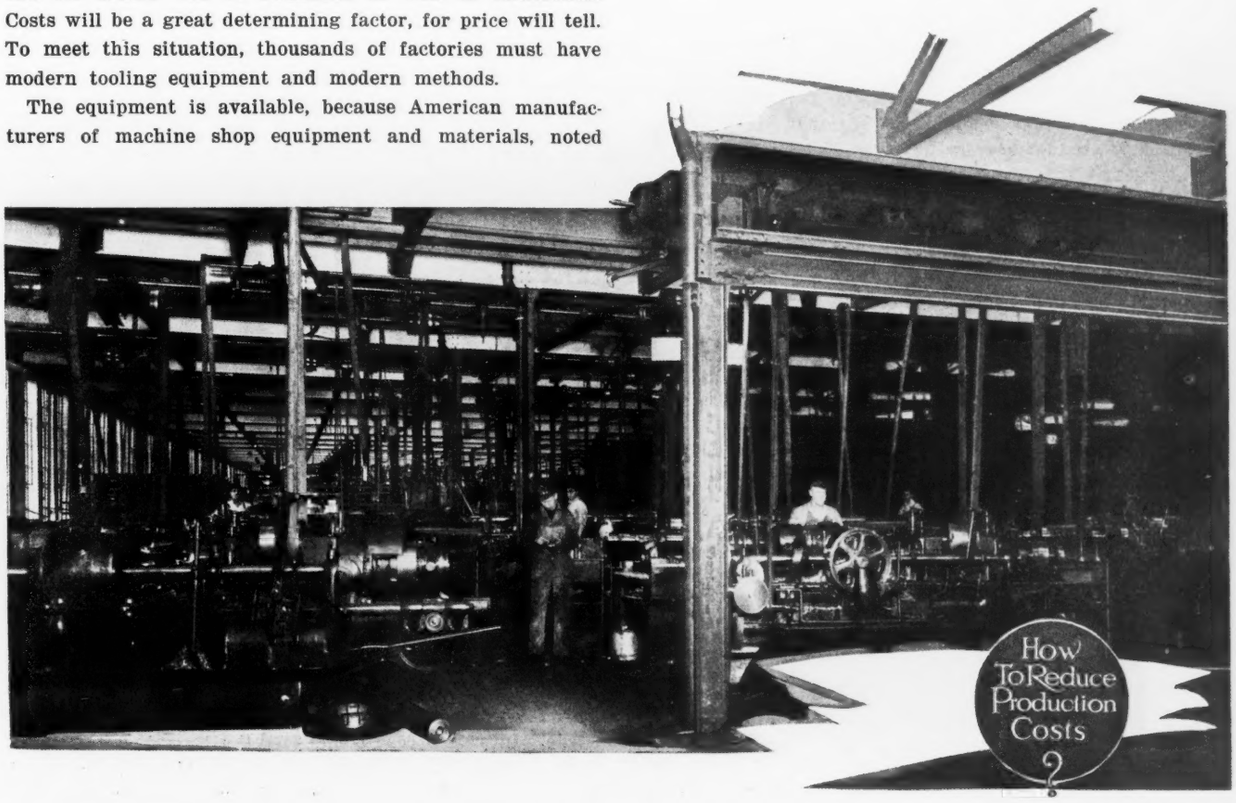
Cost reductions will come partly through more systematic and efficient management and reductions in wages; but in the field of metal-working manufacture, at least, they must come chiefly through more efficient manufacturing methods, through the use of up-to-date cost-reducing machines, tools and tooling equipment, through modern means for handling material in the plant, through using the divers time- and labor-saving methods and devices which characterize the most efficient practice. These cost reductions cannot be made with equipment that was all right a few years ago. The changes have been great as well as swift. There are new methods, devices and facilities. The pace is faster. Results are totally different from what were considered good only six years ago.

Hundreds of metal-working shops throughout the country are badly handicapped with equipment and methods which should have been discarded long ago. These factories will have to re-equip with more efficient tools and will have to bring their practice up to date. Economic law is a great steam roller. Under its cold, incessant and remorseless operation, the able and enterprising thrive and the others fail. We are in a new period of searching test—a buyer's market—with the buyers still very scarce. The contest for orders will be strenuous as well as continuous. Costs will be a great determining factor, for price will tell. To meet this situation, thousands of factories must have modern tooling equipment and modern methods.

The equipment is available, because American manufacturers of machine shop equipment and materials, noted always for inventive genius and progressiveness, made great practical use of the severe but invaluable lessons they learned in the strenuous war period, when production was the first consideration. They are ready with tools and devices capable of reducing production costs to a point hardly believed possible a few years ago. They have worked out important changes and improvements which are incorporated in the metal-working equipment now on the market.

Exhortation to reduce costs is timely and valuable, but it is better still to show the way. MACHINERY is endeavoring to do this, and in four numbers, of which this is the first, this journal is concentrating on specific descriptions of existing methods, machines, systems, tooling equipments, etc., that make definitely for economy in production. The data covered in this number and in the succeeding issues represent practical results achieved in leading shops throughout the country. Machine tool manufacturers, with their well-equipped plants and capable organizations, will be able to reproduce in any plant the unusual results recorded in these numbers of the Cut-the-Cost series.

Periods of depression like periods of prosperity are never static. The world is ever moving, and is now moving toward business recovery. This is a great and vital period of preparation. The factories best equipped when business is going well again will gain an advance over competitors. Forward-looking manufacturers are reducing their costs. There has been, very naturally, hesitation and indecision, but now the time is ripe for active preparation. The plant in need of new equipment for reducing manufacturing costs cannot afford to delay. It is a buyer's market.



The Foreign Situation and the Machine Tool Industry

By JOSEPH KUCERA

The author of this article left for Europe early in 1919 and studied economic conditions there for over two years, paying special attention to the conditions in the machinery trade and the demand for machine tools and industrial machinery in general. After having visited twelve different countries for this purpose, he returned to the United States in the spring of this year. He went to Russia in August, 1920, and left there in December of the same year, after having visited both Moscow and Petrograd. Mr. Kucera is well acquainted with the machine and tool fields, having been connected in an executive capacity with several tool and gage concerns in New York City since the outbreak of the war in 1914.

UPON my return from Europe, I found that many machine manufacturers failed to grasp the international situation, which has a direct bearing on business conditions here. Most manufacturers, referring to the present industrial crisis, made various predictions as to its duration; these predictions, however, were based on their experience with the preceding depressions of 1908 and 1914. That was six months ago. Since then, because we have had time to study the international market, we have come to realize that our industries, being partly dependent on the prosperity of the industries in Europe, cannot expect to revive fully until the old world places her factories on a pre-war footing, at least. Had we done nothing else but study the international markets for the last few months, it would have been worth while. An optimist may even go so far as to claim that the industrial depression was the best thing that could have happened to us, since it made our study of international markets compulsory, thereby fitting us to cope successfully with a situation which we shall have to face in the near future.

There are still some manufacturers in the machinery line who hold the pessimistic view that their business will be the last to come back to a state of prosperity. They claim that other industries will be able to run with their present equipment for a long time to come, keeping the machinery, particularly the machine tool demand, at a minimum for a long period. These men, fortunately, are becoming less in number, for our compulsory international education makes new graduates every day.

German Competition and Credits

So much for the general conception of the present outlook. When we consider details, from a pure business standpoint, another pessimistic argument comes up, as follows: Germany, because of money exchange in her favor, is capturing all the European machine tool markets. But the fact is that Germany is not doing this. True enough, we have evidence of Germany exporting machine tools to other countries at prices far below our competitive capacity. She can well afford it, since her labor cost is only one-sixth of ours. But there is one thing that Germany cannot afford to do, and that is to grant credit, which means that she is not in a position to supply the demand. Therefore, the German export of machine tools will meet a very small percentage of the demand, and will remain at this point for many years to come.

Long-term credits on a large scale are necessary for the rehabilitation of Europe. Only the big financial interests of the United States can and will extend these credits, since non-productive Europe means the ruin of many industries in America. As a common-sense business principle, this credit will not be advanced to a competitor—in this case Germany. The credits will go to consuming nations, excluding Germany as the intermediary that she was before the war, if for no other reason than that the present limited purchasing capacity of Europe cannot afford to have business pass through so many hands.

Personal investigators and statistics may prove that Europe is not in great need of machine tools—that prior to these she wants raw materials to put idle machinery into motion. That is true enough; yet Europe is coming to realize that her economical rehabilitation does not depend only on resuming pre-war production, but on producing far in excess of that, not only in order to pay her debts, but also to regain her pre-war living standards, poor as they were compared to the standards in the United States. And to attain this end will require the Americanization of production, with American machine tools to begin with.

Russia as a Potential Market

Even though Europe were satisfied to retain her present economic standards, and not become the eager customer for our machine tools that we expect, there is still one country that cannot get along without our machines, and that is Russia. Russia needs everything, but particularly machinery of every description, including machine tools. She will be able to get along for a few more years with her old clothes and to live on small rations; but she must have railroad equipment, locomotives, mining machinery, and machine tools to begin with, if she expects any credit from the United States at all.

Russia is richer in natural resources than the United States. Considering this as an asset, we might say that Russia is the only solvent country in Europe. Yet she must go into the hands of a receiver if machinery is not put into motion to exploit her wealth immediately, for her wealth is worthless unless it is turned into products. Directing the export of our foodstuffs and clothing into Russia, without at the same time providing the country with the machinery of production, would be equivalent to giving credit to a concern in the receiver's hands. It cannot be done.

For the time being we may discard our worries in regard to political complications. Even though Russia remains under the present régime we shall, nevertheless, finally be obliged to do business with her. If she should abolish her present system of government before we entered into commercial relations with her, the international economic situation would remain very much the same as it is today. However, since we are considering political eventualities, suppose that the present régime were overthrown some time after we had begun to do business with Russia. It might be thought that if the Bolsheviki were overthrown a new destructive struggle would arise in Russia. People well informed on the Russian situation, however, are convinced that the Bolsheviki are too exhausted for any formidable struggle in the event of their overthrow by the Russian people. In such a case trade with the United States would go on as usual, and the economic life would not be deranged any more than by a change of cabinets in other countries.

Germany cannot reconstruct Russia. It will be done by the only nation today capable of a work of such magnitude —the United States. Germany and other countries in Europe have been doing business with Russia for over a year, yet Russia is still sending calls of distress for everything necessary to save a sinking nation from complete economic shipwreck. Why have Germany and these other nations not exported to Russia at least enough to keep the wealthiest country in Europe from appealing at this hour for help to save it from destruction by famine? Because Russia needs credit, which no other country but America can afford to give her.

Conditions in Russian Industries

During my stay in Russia in 1920, I visited a great many factories. In the clothing industry, I saw people doing the work in their homes, sewing entirely by hand, and this was being done even in the garment factories, while many sewing machines stood idle. One of these machines, I observed, was in perfect order, except for the flywheel bracket. Bringing this to the attention of the superintendent, I expressed amazement at the piece of cast iron not being replaced, so that the machine could take the place of a few of the hand workers. "I know," he replied instantly, "but where will we get the cast iron?" This is typical of the situation throughout all the Russian industries—where to get the cast iron—while there is enough of it in Russia to supply half the world.

In a machine shop in Moscow, equipped to employ several hundred men, I saw an engine lathe idle because it had no apron. The foreman stated that it had been taken off because it contained a pinion that was needed elsewhere. I saw rust eating away a shaper—one of those heavy European imitations of an American machine—apparently for no other reason than that a gib, which presumably was taken to be used on another machine, was missing. I could give endless examples of instances in which machine tools are idle and useless, and becoming fit for nothing but scrap, simply because the Russian workmen have no more mental or physical energy left to think out a way of making at least one working shaper out of several of similar make.

The same conditions prevail in the textile industry—in fact, everywhere in Russia where a wheel used to turn. Imagination is not sufficient to picture the industrial breakdown of Russia. I had to see it with my own eyes—machines without gears, gears without teeth, a huge scrap heap. Germany and other European countries have been selling agricultural machinery, motor trucks, and other machinery to Russia for some time past. These, of course, have all been spot cash transactions, mostly in gold. Today Russia's ready gold is exhausted, and she has nothing in the line of raw materials to offer. Therefore, it is left entirely to the United States to put the Russian industrial scrap heap on a productive basis, and in this task the American machine tool will play the most important part.

Pre-war Trade Channels

Russia's total exports in 1913 exceeded her imports by 240,100,000 rubles (gold). Her imports from Germany alone, however, exceeded her exports to that country by 190,100,000 rubles, while her exports to all countries except Germany exceeded her imports by 430,200,000 rubles. These figures prove clearly how Germany made other countries pay for her business in Russia, particularly for German machines, since machinery and manufactured goods formed the bulk of the Russian purchases abroad, while her exports consisted chiefly of foodstuffs and raw materials. In the past Germany was practically the exclusive agent for American machine tools on the continent, and it goes without saying that she naturally discouraged the purchase of American goods for the sake of stimulating her own production. In Russia, a German concern acting as agent for an American manufacturer charged $1350 for an engine lathe bought for $600 F. O. B. New York.

Credits the Chief Problem

As the situation in Russia stands at present, it will require untold millions to meet the country's needs in machinery alone. Even assuming that western Europe is capable of supplying half the requirements, there will still be a market for large quantities of machinery from the United States, and this source of supply will be drawn upon in preference to any other, because the United States will extend credits. In mentioning credit to Europe or Russia in these days, it does not mean that any individual manufacturer or group of manufacturers is expected to advance credit, as has been customary in the past. It is being generally appreciated that our economic problems of today are a part of the problems of the whole economic structure of the world, and cannot be solved by any group of industrial or financial organizations alone. The solution lies in concerted action, and arrangements are already being made to approach this difficult subject.

The best proof of European inability to extend long credits to Russia today is the attempt made to solve the Russian economic problem by barter, which amounts to an exchange of goods or raw materials in kind—in other words almost a cash transaction. In Sweden, corporations with two hundred million dollars capital have combined for the explicit purpose of doing business with Russia on the barter basis, and no doubt other countries will follow Sweden's example, especially now since many of them have already had experience in business by barter. There is no doubt that the United States will launch much of her international business on a bartering basis. Of course, barter is only resorted to in this emergency because the trust in the capability of certain countries of meeting bills has been shaken, and as soon as positive signs of the restoration of an economic balance are in sight, it will be abandoned. In the meantime, in order to facilitate the economic regeneration of the world, the industries will have to draw on the capital that is left, and that is concentrated in the United States. This country cannot escape from extending credits; otherwise, our industries will have to run at a low capacity. And it takes machine tools to act as an insurance on this credit—to facilitate quick payments on the money advanced. It takes production to pay the debts, for no one will advance money to an idler; yet Russia cannot begin to produce until she is fitted out with machinery. It is a problem of vast proportions, and one not easily solved; but it will do a great deal of good to begin thinking about it.

* * *

FRENCH BUREAU OF INDUSTRIAL AND SCIENTIFIC RESEARCH

During the war France mobilized her scientists and laboratories into a Bureau of Industrial and Scientific Research and of Inventions. The French Government has decided to maintain the existing organization, and to adapt it to the needs of peace. It works in conjunction with both public and private laboratories, and encourages inventors, assisting them to turn their often vague and impractical ideas into concrete and useful form. Proposals of inventors are first brought before a committee which eliminates Utopian ideas and those without practical value. The promising projects are referred to competent technical committees, who get in touch with the inventor, aid him in his research, assist him in making models, guide him to a definite embodiment of his conception, and, in some cases, point out to him practical applications that he has not previously thought of. Since 1919 more than 500 proposals have been considered.

Another phase of the work is the assisting of scientists who have a valuable idea, but lack material, apparatus, or other means to conduct experiments, until it is embodied in a practical application. The bureau is also ready to assist the industries, and a constantly increasing number of managers of industrial concerns are submitting problems.

New Type of Thread Gages

An Accurate Method of Determining the Correctness of Screw Threads by Vision as Well as by Touch

By B. M. W. HANSON, President, Hanson-Whitney Machine Co., Hartford, Conn.

Fig. 1. New Type Thread Gage with U. S. Form of Thread

THERE are four dimensions that are important in the making of a good screw: First, the lead; second, the diameters on the top, at the pitch line, and at the bottom of the thread; third, the shape or angle of the thread; and fourth, the roundness and parallelism of the screw. All these dimensions can be determined by separate gages used by a skillful operator, and when accurate work is required, the inspection of all these dimensions becomes expensive and tedious.

The common practice of gaging screws, as is well known, is to use a thread gage composed of a tapped hole, sometimes solid and sometimes adjustable, and to determine the size and correctness of the screw by simply screwing it into the gage. If it goes in without shake, it is generally accepted as being of correct size. If it does not go in, the screw is regarded as too large, and the thread cutting tool, of whatever construction it may be, is adjusted so as to reduce the size of the screw until it goes into the gage; but it is impossible by this method to determine whether the screw thread has proper contact with the gage. The bottom of the screw thread may fit the thread in the gage on its smallest diameter and yet not fit anywhere else. The top of the screw may fit the largest diameter of the thread in the gage and the rest of the dimensions have no fit, and the angle of the screw cutting tool may be different from the angle of the thread in the gage. A screw may go into the ordinary thread gage a few threads and not go any farther, not because the shape and diameter of the thread are wrong, but because the lead of the thread on the screw is different from the lead of the thread in the gage. A screw may be out of round, and will fit the gage at two points, but not fit all the way around. All of these conditions cannot be tested by a thread gage of the type generally used.

Assume that a hole is tapped with an accurate tap and is deep enough for the screw to go in two diameters. Assume further that the screw has been gaged with a gage that is three-fourths of the diameter of the screw in thickness. While the screw may fit this gage, it does not necessarily mean that the screw will go in the full depth of the hole. The difference in the lead of the thread on the screw and the thread in the hole may cause trouble. If, on the other hand, a gage is made the same thickness as the depth of the hole, the screw is supposed to fit. In that case the operator generally reduces the diameter of the screw until it will go in the full depth, and if the work is important and an accurate fit is required, the screws may all be spoiled, as the operator has no means of determining the accuracy of the lead.

The illustrations in connection with this article show a thread gage that will determine whether all dimensions of a screw are accurate or not. This gage is composed of a C-shaped frame in which are mounted two hardened jaws, each jaw having grooves corresponding in shape and pitch to an accurate screw plug. These grooves are finished correctly after hardening, so that they are parallel with each other and at an angle corresponding with the lead of a plug gage. In one of the jaws there is a groove that crosses the thread grooves at approximately right angles. The opposite jaw has no such groove and is adjustable on the frame for different diameters. The adjustment is accomplished by a wedge at the front end of the jaw and a push-screw at the rear end of the jaw. The jaw has a tongue that fits in a groove in the frame, and two screws enter the jaw approximately in the middle of the tongue and pull it tightly against the wedge and the push-screw.

A double-ended plug, accurately finished, is furnished with the gage, for setting it correctly, as shown in Fig. 2. One end of this plug is generally made the maximum diameter desired, and the other end is finished to the minimum diameter required on the screw. In setting the gage, the front end of the adjustable jaw is adjusted with the wedge to the maximum diameter of the plug, and the rear end of the jaw is adjusted with the screw to the minimum diameter of the plug. Therefore, it is clear that this adjustable jaw is set at a slight angle to the opposite jaw, in order to obtain the maximum and minimum dimensions on the gage.

In gaging a screw, it is simply passed into the front end of the gage, and if it goes in without passing through the opposite end of the gage the screw is correct as to diameter within the limits desired. The groove running crosswise of the threads in one jaw aids in determining by touch when the screw has reached the ideal diameter; if the screw crosses the groove into the remaining part of the thread the operator can determine how near it is to the minimum diameter. The thread grooves in both jaws being at a slight angle corresponding with the lead of the thread, and the angles being opposite to each other on the two jaws, it would be impossible

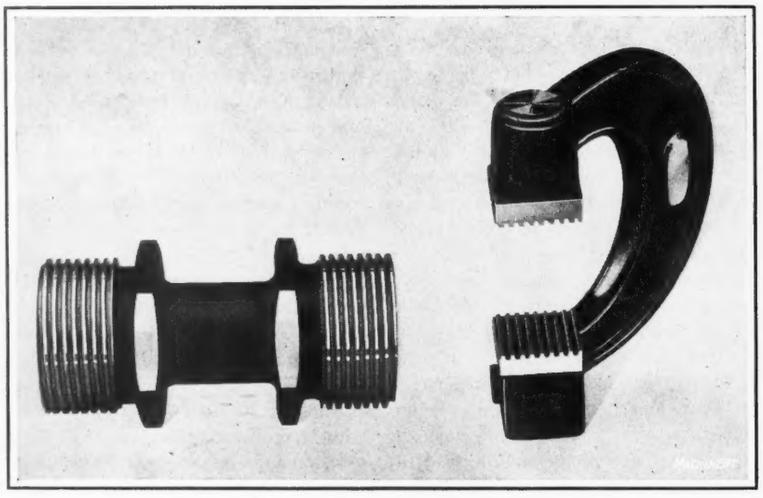


Fig. 2. An Acme Thread Gage with Plug for setting to Size

to pass a screw through the jaw if the jaws were rigidly connected with the frame. Therefore, the construction is such that the jaw opposite the adjustable one can slide in the direction of the axis of the screw being gaged. This slide is accurately finished, and the jaw is held against the frame by spring tension, so that no dirt can work in between the jaw and the frame at any time.

The C-part of the frame being at an angle of approximately 45 degrees with the grooves of the jaws, makes it possible to hold the gage up to the light without having the frame obstruct the view. Therefore, when a screw is put in the gage, by holding it up to the light, it is possible to see how the thread in the screw corresponds with the thread in the gage. If the bottom of the thread in the screw touches the top of the thread in the gage, it is easily detected by holding it to the light. The same is true if the angle of the thread does not correspond with the angle of the gage, or if the lead of the screw does not correspond with the lead of the gage. By turning the screw around in the gage it is easy to feel whether it is round or not.

The frame is so designed that the gage can be snapped on a screw of any length, as it will not obstruct the passing of the gage entirely over the screw. The width of the jaws can be made to any desirable dimension, but the practice is to make the jaws for all screws over ½ inch in diameter, 1 inch wide; for screws between ½ and ⅛ inch in diameter, ½ inch wide; and for screws smaller than ⅛ inch in diameter, ¼ inch wide.

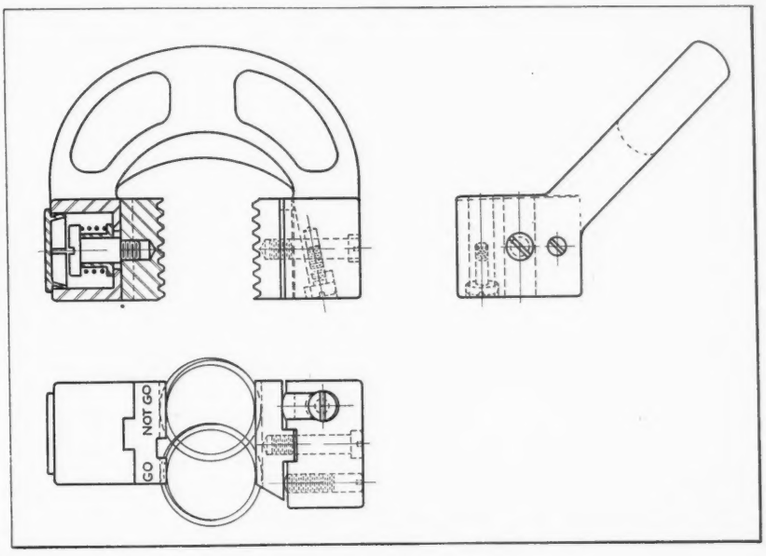


Fig. 3. Construction of the New Hanson Thread Gage

In places where thousands of screws have to be gaged every day it is an expensive and tedious task to do this work with an ordinary gage. By the use of this new gage the work can be done speedily and with very little effort. When setting up a screw machine, the screw can be gaged before it is cut off from the rod in the machine, and the die can be adjusted until the correct size is obtained. Fig. 1 shows a gage for the U. S. standard form of thread, and Fig. 2 for the Acme form of thread, but any form of thread gages can be just as easily made.

After long usage, the jaws of the gage may become slightly worn. In that case they may be readjusted to the plug very quickly. If they have been used so much that the measuring points are worn away, new jaws may be attached to the frame, as all the jaws are made interchangeable with the frame. From the illustrations and description it may be seen that in gaging screws with this type of gage, vision as well as touch is used, and that the speed and accuracy of gaging are very valuable features of this gaging method. A number of gages of this type are now in use, and have proved to be entirely practical. They are manufactured by the Hanson-Whitney Machine Co., Hartford, Conn.

* * *

Indications of increased activity are apparent in the Canadian iron and steel industries. Two of the largest steel plants in Canada are working on orders which will keep them busy for some months, and several of the large steel plants are now occupied at about 70 per cent of their capacity, according to a recent report by Consul F. S. S. Johnson.

LET US GO TO WORK

By J. E. KELLEY, General Sales Manager, Simonds Mfg. Co., Fitchburg, Mass.

For the last twelve months we have been liquidating. We have all been wearing out our old shoes and our old clothes, patching up our tools, reducing our stocks, and getting along without purchasing, except for essentials absolutely necessary to carry along our very much depleted business. We have cut out extravagance in so far as purchasing materials is concerned, but statistics prove that we have added another far greater piece of extravagance to our list than any heretofore indulged in, and that is the extravagance of wasted time. We have reduced our energies in greater proportion than our expenses, and most of us find ourselves today wastefully waiting and watching for the gold nuggets to come to us. In other words, we have stopped hustling.

It was the writer's personal privilege to visit Japan shortly after the Russo-Japanese War, going as far north as the island of Hokkaido and as far south as Nagasaki, and at that time all Japan had been advised by a circular letter from the Emperor to curtail all expenditures possible—to get along with as little as possible. They were certainly doing that. People were without shoes in the coldest part of winter and were using ordinary sacking to wrap their feet in. They had no knives and forks to eat with, no chairs to sit on, and hardly any of the ordinary comforts of life. They were getting along without much of any expense, but they were not producing. They were undergoing hardships and were not profiting by it. They had allowed the idea of curtailment and penury to supplant action and work.

As I view the last twelve months here, I can see a considerable similarity to conditions in Japan after the Russo-Japanese War. We can get along on very little if we force ourselves to do so, but what do we gain by it? The world needs products, and all kinds of products. In our opinion the best thing for all of us to do is to take our losses and start in to work and build up again; mark the prices of our goods down, and cut the price of labor down; and insist on more hours work from every employe and more active work from all salaried employes. By the reduction of prices those working for a lower wage will procure as much, or nearly as much, as during the war period. We all need to stimulate activity in business. This slothful waiting is going to hurt everyone.

Let us think this over and see if we cannot adopt a new trend of thought which will help us to get busy, for that is the one thing that will change present conditions.

* * *

American automobiles dominate the South African market. In 1920 nearly 7500 cars were imported, and in 1919 over 4000. These imports are practically double those of all other countries combined. Canada is credited with having exported 2350 cars to South Africa in 1920. These are, however, from Canadian branches of American companies, the cars being shipped from Canadian factories whenever possible, because of lower freight rates and lower import duty.

Production Control by Graphics

A System Employing Graphic Charts for Controlling Shop Operations, in Use in the Plant of the Hopedale Mfg. Co., Milford, Mass.

By FRED R. DANIELS

How To Reduce Production Costs ?

THE system described in this article was formulated to suit the requirements of the Hopedale Mfg. Co., builder of cotton looms and automatic attachments for looms, by L. V. Estes, Inc., Chicago, Ill. The success of this system, as of all systems, lies in the definite functioning of the members of the organization after a plan has been accepted as suitable. At the time of installation it was realized that certain readjustments and changes in equipment were necessary in order to pave the way for the work which the system was designed to control. First, the control of material was felt to be of such vital importance that proper storage space was sought which would facilitate the handling of all material in storage. In the designing of the stock-room, certain features were incorporated which aid greatly in receiving material, making inventories, and delivering stock. A portion of the stock-room is shown in Fig. 1. Desk room is provided for the storekeeper at the left and there is a similar open area beyond the bins for the storage of large bulky material.

At the rear of the bins there is a passageway running along one wall of the building from which steps lead up to sets of bins located about four feet from the floor level. Between these sets of bins are other passages on the floor level through which the material is transported to and from storage. Other bins are located on each side of these passageways, accessible from the floor, the arrangement permitting all bins to be reached without the use of step ladders; good natural lighting is obtained from the windows in the passageway at the rear.

General Principles of the System

The details of the control system require the use of graphic charts, the information for these being obtained from a standard part analysis, which is made for every part that is handled. Boards carrying the cross-section paper used for charting are erected, which are capable of handling rolls of fifty yards of paper, so that as the graphs are laid out the paper may be rolled on the left-hand roll. The boards are arranged to slide vertically to suit the convenience of the control board operator. These boards will accommodate several rolls of paper, and are installed in the office of the production department, under whose direct supervision the control system functions. Fig. 2 is a view of a section of one of these control boards. In conjunction with the operation of the control boards a dispatch board is used. The dispatch board is dependent upon the operation of the control boards, and forms the link between the planned and the accomplished work. Each of these elements in the control system will be dealt with in detail in this article.

The dispatching and scheduling of jobs to work stations, or machines, gave rise to the necessity of rearranging many of the machines and numbering them by groups, or individually, as determined by the production supervisor. The tote boxes are also numbered, for the distinct location of jobs going through the factory requires not only that the work station be designated but also that the particular receptacle in which the parts are contained be recorded. Three branches of the organization are involved in the system.

The engineering department makes up master specifications of all parts to be made. These master specifications are one of the three controlling factors of the system, and furnish the manufacturing committee and the production department with information for conducting the routine.

Without an adequate production system and suitable means for controlling and checking up production, even the best machine tool equipment and the most advanced methods may prove of little value in reducing production costs. If the superintendent or production manager cannot at all times keep in close touch with the flow of production through the plant by means of an adequate system, it is not possible for him to rectify errors quickly and stop wasteful practices that may clog the channels of production. In a large plant especially, costs are reduced not merely by up-to-date equipment and a well-trained corps of workers, but also by proper methods of following the results obtained in production, so that steps can be taken immediately to check any waste and leaks that would prove costly in the long run.

The manufacturing committee, with the aid of the master specifications, determines upon the rate of production, and establishes a production period which is of such duration as to enable work in process to reach the shipping room in time to meet the promised delivery. In the present case this period is taken as one month, and all orders for material such as castings are based upon this monthly period.

The production department, under the direction of the pro-

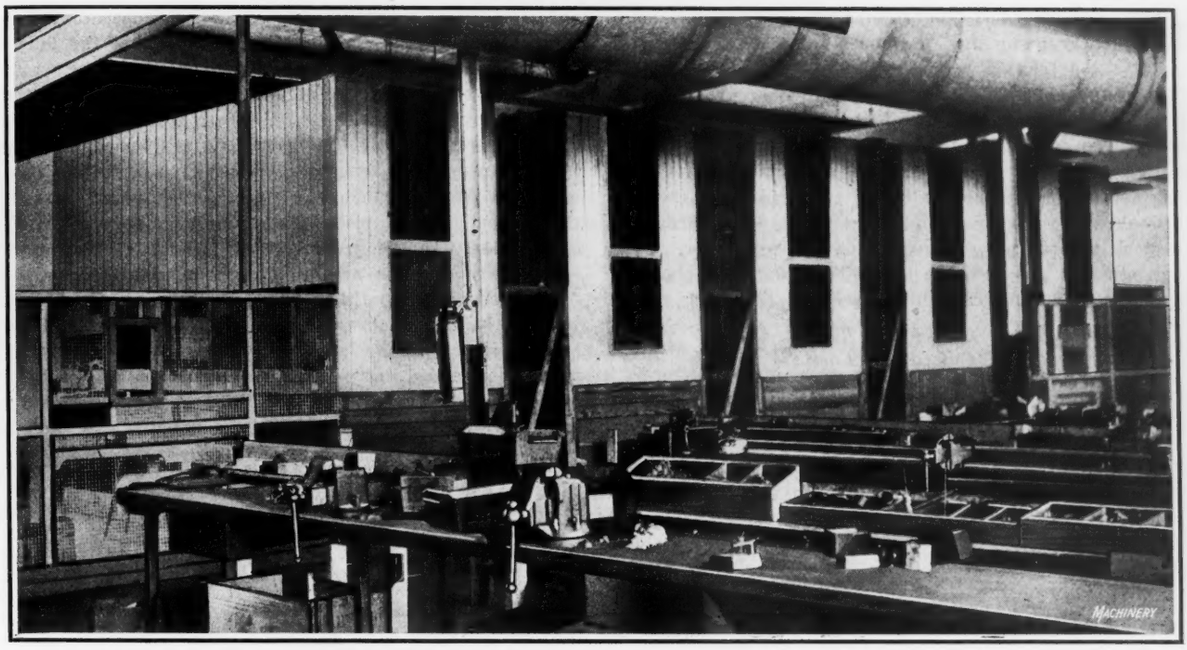


Fig. 1. Stock-room arranged so that the Bins may be reached without the Use of Ladders

duction supervisor, is responsible for all material both in process of manufacture and in stock. The routine within the storage room before and after making and at the dispatch board during the process of manufacture, as well as the actual laying out of the graphs on the control boards, is directly under the supervision of the head of the production department.

Important Factors in the System

There are three important factors that form the basis for the graphic control of parts in process of manufacture. These are (1) master specifications; (2) stock records; and (3) standard part analyses. The master specifications are simply complete lists of all units and sub-assemblies which are used in the construction of any one product. They furnish the production supervisor with definite knowledge regarding quantity.

In conjunction with the master specifications, records must be made on the stock record card, Fig. 3. This card shows at a glance if material must be requisitioned to meet an order, or what part of the order must receive such attention. The upper right-hand corner of this card gives the information relative to the location of the material in the stock-room, and does not pertain to the control elements of the system. The entries in the upper left-hand corner "Minimum to Carry" and "Maximum to Carry" furnish the production department with the information for determining the number of pieces required to be ordered.

In the present case the card shows that it is necessary to carry fifty friction collars H-892 as a reserve, but that it is permissible to carry as many as two hundred of these parts. The closer the limits between the minimum and maximum quantities permissible to carry in stock, the better, because it is inadvisable to tie up a considerable amount of money in stock except when this is necessary to safeguard against shortage in filling an order. This maximum quantity is usually established by estimating the largest amount that would be needed at any time to carry the shop along for a period sufficient to complete another lot.

The entries in the requirements section are first made, and if these requirements cannot be met by the balance available (see the column at the extreme right) and still leave a reserve above the minimum, an order is immediately entered which will supply the deficit and bring the balance available up to the requirements. For example, the first entry shows that 475 parts were required and that but 500 were carried in stock at that time, so that there would be a balance of only 25 castings, which is below the minimum specified. It was therefore decided that an order of 325 would bring the balance available (after meeting the requirements of order No. 520) up to a point which would be considered safe.

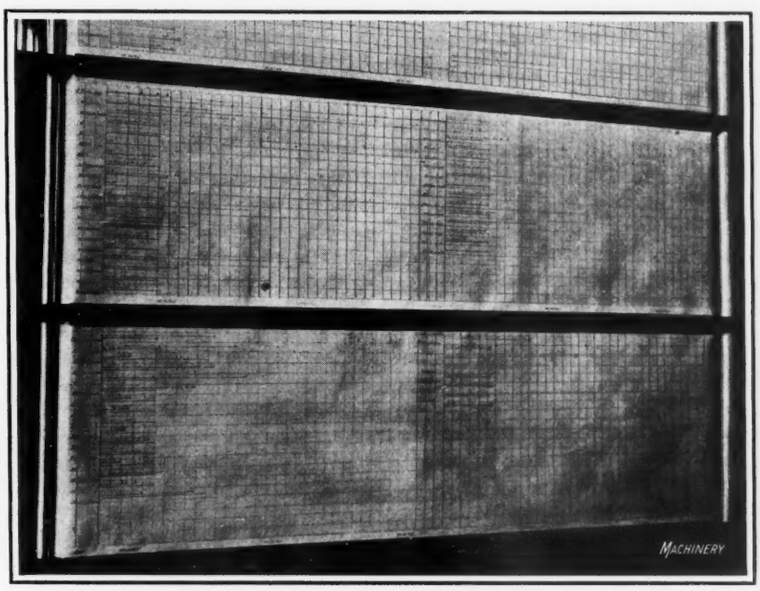


Fig. 2. Arrangement of Control Board for holding Charting Paper on Rolls

The disbursements for the first item entered under the requirements section were made on the 5th and 6th of the month, respectively, and the quantities properly deducted as shown. At the same time receipts are shown to have come in on order No. 1325, which was entered on the 3rd of the month, and these are carried over and included in the new available balance. This procedure enables the quantity

actually in storage to be determined at any time, this being the last entry under the "Balance Available" heading—in this case 150 friction collars.

The rough stock and the finished stock are recorded on the same kind of cards, except that they are of different colors. The entries on these cars are made from foundry manifests, material requisition slips, etc., the requirements being determined by the production supervisor. In the case of rough stock, the immediate procedure, after consulting the stock record card, is to issue a foundry order, if the rough stock is not adequate to fill the order, and the data on the foundry order are then placed on the stock record card.

The Standard Part Analysis

The standard part analysis is an indispensable factor in the operation of the system, and forms the basis from which the time element is derived. Figs. 4 and 5 show the form in which these analyses are made. Fig. 4 is for a friction collar assembly, and the information regarding duration of time for this and all other standard part analyses is taken from a time study of each operation. The time unit used is the hour, and the quantity of parts upon which the analysis is based is 100 parts.

PART NO. H - 892 | PART NAME OR DESC. Friction Collar | LOCATION T - E - 16

MIN. TO CARRY 50 | USED ON Model A- Loom | QTY. REQ'D PER UNIT One

MAX. TO CARRY 200 | **Stock Record Card** | PURCHAS'D IN UNITS OF Pieces

HOPEDALE MFG. CO. MILFORD, MASS.

REQUIRMENTS					ORDERED				RECEIVED				DISBURSED				Balance
Date	Req'd for	Q't'y	Acc. Qty.	Bal. Req'd	Date	Order No.	Qty.	Acc. Qty.	Date	Order No.	Qty.	Acc. Qty.	Date	Lot No.	Qty.	Acc. Qty.	Available
1	520	475	475	25	3	1325	325	325									500
													5	520	300		200
									6	1325	50		6	520	175	475	75
									7	1325	100	150					175
									10		175	325					350
11	620	550		0	12	113	350	675									
													13	620	150	625	200
									14	113	100	425					300
									15	113	150	575					450
									17	113	100	675	17	620	400	1025	150

H. M. CO. FORM L.V.E. 138

Fig. 3. The Stock Record Card which shows the Balance Available at Any Time

It will be seen that the first operation is performed at the work station or machine number B-41, and that ten hours are required for the operation. The time is shown graphically by a horizontal line, extending from 0 to 10, and the time for the subsequent operations is shown in a similar manner. The time allowed for the subsequent operations so overlaps the time determined for preceding operations that when an operation has been completed on a certain number of parts in a lot, the subsequent operation is started before the entire lot is completed. This is shown by the overlapping of the graphs in Fig. 4. In this way it is possible to finish all the operations on a lot of pieces in a much shorter time than would be possible if one operation was completed on all the pieces before the following operations on the same lot were started. In determining upon the time to start work upon subsequent operations, care must be taken to allow sufficient time so that the finished pieces from the preceding operation will continue to flow at a steady rate, making it unnecessary to wait for them and thereby lose time.

The overlapping of the operations is termed "compacting," and as will be seen from the comparison at the bottom of Fig. 4, the total time required for finishing all the operations upon a lot of pieces is considerably reduced by this overlapping. In the present case fifteen hours are gained —all the operations are performed on the 100 pieces in fifteen hours less time than would be the case if each operation on the entire lot was entirely completed before the following operation was started. Compacting is permissible and recommended in assembling work, but in the machining of a part it is inadvisable to start lots of less than 100 before the operation on the preceding machine has been finished. In assembling, however, dividing the lots into quantities as small as twenty-five will not result in confusion, but on the other hand, will greatly aid in maintaining the continuity of flow of finished work.

An inspection of the standard part analysis for the friction collar H-893, Fig. 5, shows that no attempt is made to save time by overlapping the operations, although in handling quantities of 500 or 1000 it is permissible to split the order into lots of 100 and compact the operations without causing confusion. Thus the total schedule time and the operating time in this case are equal. Attention is called to the fact that the time required for setting up and taking down a machine for each operation is also included in these part analyses. By so doing it can be definitely established when a machine is again ready to handle another operation. It will also be seen that a section of the form is provided for the cutting speeds and feeds, as these data are of value in establishing standard time factors.

The Graphic Scheduling of Material

Two different control boards are used for scheduling material and operations. The material is scheduled by graphics

on standard cross-section paper, and this chart is called a material and flow board. The scheduling of operations, or "loading" as it is called, is graphically shown on a similar control board, called the load board. Scheduling and flowing is the first phase in production control by graphics, and applies only to the turning out of finished work. For this reason attention need be centered only on the last operation, and it is the scheduling and flowing of the last operations which are entered on the schedule and flow board and which definitely determine the starting and finishing hours for all operations later entered on the load board. On both charts colored crayons are used to differentiate between scheduled or anticipated time and the flow or actual attainments. Fig. 6 shows a section of the material and flow board, illustrating how the friction collar assembly HA-892 and the friction collar H-893, which is used in the assembling, are scheduled. Three distinct colors are used for the graphs—blue

STANDARD PART ANALYSIS

HOPEDALE MFG. CO.
MILFORD, MASS.

H. M. CO. FORM L. V. E. 129

THIS ANALYSIS IS BASED ON 100 UNITS — KIND OF PART ✓ SINGLE PART / SUB-ASSEMBLY — DATE ISSUED Dec. 29-20

MATERIAL SPECIFICATION

	Kind of Material	Specification	Rough
For Castings			Wt. Each / Wt. per 100
For Sheet or Strip		Width / Thickness	Max. Length of Stock
For Bar Stock		Diameter	Max. Length of Stock
For Other Material			

PURCHASED IN UNITS OF

PART NAME: FRICTION COLLAR ASSEMBLY — PART No. HA-892

USED ON

No.	Desc.	No.	Desc.
	New Loom		

DRAWING No. HA-892 — PATTERN No. HA-892 — COMPILED BY L.O.S. — APPROVED BY G.K.

Operation No.	Mach. No.	Dept. No.	Operation Name	Tool No.	Operation Instructions	SET-UP SKETCHES	Cutting-Speed & Feed: Spindle Feed per Min.	Feed per Rev.	Feed in Surface Feet per Min	Setting-Up Time (HOURS): Tool Set-Up Time	Tool Take-Out Time	Total Tool Setting Time	Total Act. Run'g Time per 100 Pcs (HRS)	Total Operating Time per 100 Pcs Based on 100 Run (HRS)
			Finish Stock											
1	B-41	4	Assemble		Apply Collars								10.00	10.00
2	B-42	4	"		468 Press Col. pin brs in rd.								12.00	12.00
3	B-43	4	"		Fit bearing shells								5.00	5.00
4	B-44	4	"		Assemble connecting rd.								5.00	5.00
			Finish Stock											

How the Operations are Represented Graphically

A section of the load board is shown in Fig. 7. Information relative to the delivery of work from one machine to another and the daily production rate is entered above the graphs. The standard part analysis Fig. 4 has shown that the last operation on the friction collar assembly is performed by machine No. B-44; consequently opposite B-44 on the load board the starting and finishing time for this operation are indicated. In order to preserve continuity and steady flow of operations, it is advisable to have one day's production ahead of the schedule; also a certain time should be allowed for inspection and handling the work. The latter factor will be determined by experience and knowledge of the actual conditions, but for the purpose of illustration it may be assumed to be one-half day. This means that Operation 4 will start one and one-half days, or fifteen hours, in advance of the actual scheduled time for start of flow as defined on the material and flow board, Fig. 6. Fifteen hours in advance of 4:45 P. M., July 7 brings the actual starting time for this operation to 10:45 A. M. on July 6, and this is indicated on the load board by a vertical line as shown.

The total consignment calls for 500 units, but since 75 have been taken from stock for this order, it is only necessary to make 425 new units, and this is the amount which will be shown graphically on the chart. It requires 21¼ hours to make 425 units, based on the time estimate for this operation as determined from the standard part analysis, Fig. 4. This makes the finishing hour at 12 o'clock, July 8. Having established the limits within which this operation should be completed, and loaded the starting and finishing dates properly on the chart, the other operations are loaded against their respective work centers in the proper time relation, as defined on the standard part analysis for this sub-assembly. The notation 720 is the order number, 7 standing for the month and 20 for the year, and all parts entered on a July order bear this number. The part number is also shown, as well as the operation number, the machine to which the material is next delivered, and the estimated daily production.

Further Details in the Charting of Materials and Operations

This loading of the operations has placed the starting hour for assembling these units at 11 A. M., June 28, and it is in relation to this date that the starting time for machining the collars required in this assembly is determined. It is advisable to have one standard lot, or 100 finished units, of friction collars H-893 in readiness for assembling before the first operation in assembling is commenced, which, with a time allowance of ten hours for handling and inspecting the parts, makes a period of seventeen hours that Operation 4 on part H-893 should start in advance of the assembling work. This fixes the zero hour as 9 A. M., June 25, and this is indicated in Fig. 6 by a vertical blue line. Fig. 5 shows that seven hours are required to finish 100 parts on Operation 4. The anticipated date for completion

STANDARD PART ANALYSIS

HOPEDALE MFG. CO.
MILFORD, MASS.

H. M. CO. FORM L.V.E. 129

THIS ANALYSIS IS BASED ON 100 UNITS | KIND OF PART: SINGLE PART ✓, SUB-ASSEMBLY | DATE ISSUED: Dec. 29-20

MATERIAL SPECIFICATION	Kind of Material	Specification	Rough: Wt. Each	Rough: Wt. per 100	PURCHASED IN UNITS OF
For Castings	Cast Iron	Soft	1.75	175	Pieces
For Sheet or Strip		Width / Thickness	Max. Length of Stock		
For Bar Stock		Diameter	Max. Length of Stock		
For Other Material					

PART NAME: FRICTION COLLAR — Part No. H-893

USED ON No.	Desc.	No.	Desc.
HA-892	Fric. Col. Assem.		
HA-898	" " "		

Drawing No. H-893 — Pattern No. H-893 — Compiled by L.O.S. — Approved by G.K.

Operation No.	Mach. No.	Dept. No.	Operation Name	Tool No.	Operation Instructions	SET-UP SKETCHES	Cutting-Speed & Feed: Spindle Feed per Min.	Feed per Rev.	Feed in Surface Feet per Min	Setting-Up Time: Tool Set-Up Time	Tool Take-Out Time	Total Tool Setting Time	Total Act. Run'g Time per 100 Pcs	Total Operating Time per 100 Pcs Based on 100 Run
			Rough Stock								HOURS		HRS	HRS
1	127	48	Turn		Turn & Face complete					2.00	2.00	4.00	5.00	9.00
2	73	48	Bore		Bore & Ream Pin Hole					2.00	2.00	4.00	5.00	9.00
3	74	48	Drill		Drill Oil Hole					2.00	2.00	4.00	5.00	9.00
4	202	48	Grind		Grind Diameter					2.00	2.00	4.00	7.00	11.00
			Finish Stock											

TOTAL SCHEDULE TIME 22.00
TOTAL OPERATING TIME 22.00

ALL TIME CALCULATIONS ARE BASED ON DAYS-WEEKS-MONTHS HOURS

Fig. 5. Another Example of the Use of the Standard Part Analysis Form

The stock record card for the friction collars, shown in Fig. 3, indicates that there are 150 of these collars available for use, but that 50 must be held in reserve. The 100 friction collars that may be applied to the production schedule are indicated graphically to the right of the zero hour in Fig. 6, and this brings the time for actual machining to about 5 P. M., June 25. The reserve of 50 is also indicated in red to the left of the zero hour. There are 400 friction collars required to be ordered from the foundry, and the production clerk immediately issues a foundry order for this quantity to be delivered by June 24, and at a daily rate which will be in accordance with the daily rate of production. The foundry order will stipulate the minimum daily shipment and the date on which shipment is to start.

It can readily be seen that this method of recording the progress of finished work relative to the receipt of rough material from the foundry enables the production depart-

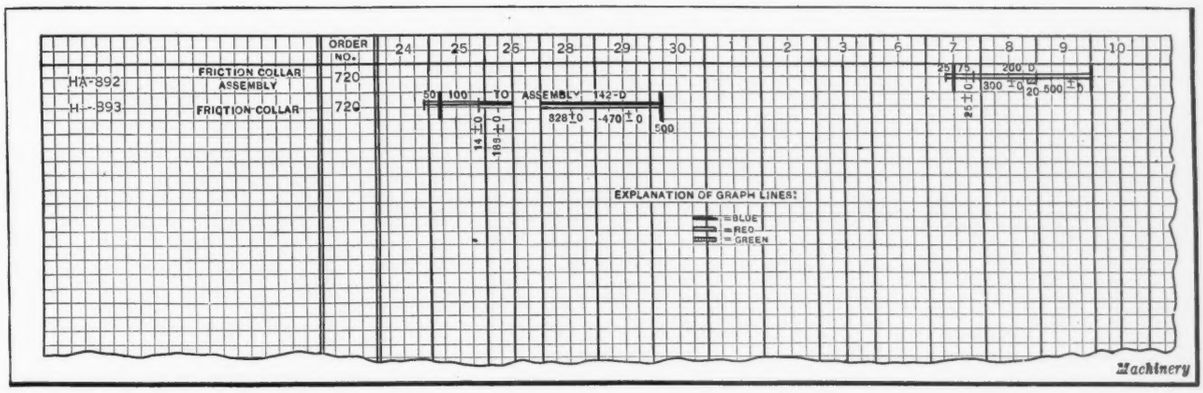


Fig. 6. Section of the Material Schedule and Flow Chart for showing graphically the Relation between Anticipated and Actual Accomplishment

ment to be in constant touch with the actual conditions, both in regard to the material being received and the relation of the progress of each operation to the established date for completion of the work.

Referring again to Fig. 7, it will be seen that the starting point of the last operation is loaded against work center 202 and scheduled to start at 5 P. M., June 25. The time for completion of the operation is also indicated by a vertical black line, this being done for each operation and the several operations being overlapped. An inspection of this load board will show that, due to compacting, 43 hours from the time that Operation 1 was started, the friction collars were completed. If overlapping or compacting were not resorted to and the standard part analysis, Fig. 5, strictly adhered to in loading, it can readily be seen that it would require 88 hours (4 × 22) to machine this lot of 400 collars. This represents a gain of 45 hours. The time required for setting up and taking down a machine is shown in advance of and at the end of each operation, respectively, this being indicated by a black line so that the exact time at which a machine will be available for a new job is at once seen.

Forms Used in Routing the Work

No actual flow of material has yet been charted—merely the loading of the operations against the various work centers in Fig. 7, and the scheduling of the last operation in Fig. 6. With the starting and finishing times indicated on both the schedule and flow board and on the load board, the control board comes into use for recording the actual production. Before production is started, however, three forms are made out by the production department. These are the productive material requisition, Fig. 8, the routing card, Fig. 9, and the dispatch order time cards, Figs. 10 and 11. These three forms are made out at the same time, and reference is made to the standard part analysis when issuing the cards.

Productive material requisitions are issued in duplicate copy and are used only for material that goes into the regularly manufactured product of the company. One copy of the routing card is made out, its purpose being to identify the work in process and to furnish the information for delivering the work in the proper sequence from operation to operation. It will be seen in Fig. 9 that provision has been made on this card for splitting lots, as would be done in machining the friction collar H-893; the routine recorded on this card is made out from the standard part analysis. When a lot is split, information relative to the number of the tote box and the quantity contained in it are entered on the card; also the quantity in the entire lot, and the number of the box from which the material was taken. When

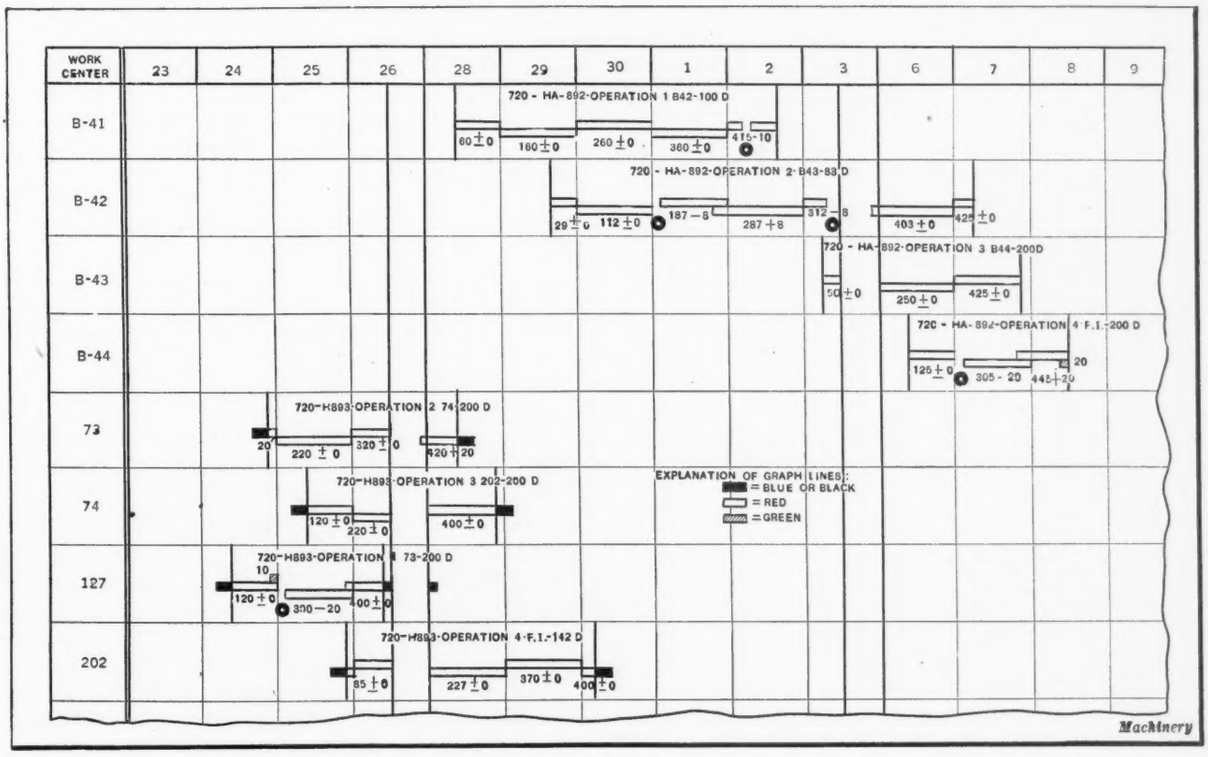


Fig. 7. A Portion of the Load Board on which the Schedule of Each Operation is indicated graphically Relative to Dates and Work Centers

DELIVERY
TIME TO DELIVER — DATE | TIME
ACTUALLY DELIVERED — DATE | TIME
DEL'R TO — DEPT.
MACH. NO. | CLOCK NO.

PRODUCTIVE MATERIAL REQUISITION
HOPEDALE MFG. CO.
MILFORD, MASS.

STORESKEEPER: FURNISH MATERIAL AS SPECIFIED. STATE AMOUNT AND TIME DELIVERED, AND SEND THIS REQUISITION TO PRODUCTION DEPT. AT ONCE.

PART DESC.

OPERATION | OPER'N NO. | ORIGINAL CONTINUATION RE-OPERATION

IDENTIFICATION
LOT NO.
ORDER NO.
FOR PART NO.

QUANTITY REQ'D	QUANTITY DEL'D	BAL. TO DEL.	DESCRIPTION OF MATERIAL	PRICE AMT.	PRICE PER	AMOUNT

H. M. CO. FORM L. IV. E. 124

Fig. 8. Form used for requisitioning Productive Material

an order is split, a duplicate card is issued and the proper entries are made in the deliveries section in order to permit the various lots on the order to be traced during the process of manufacture.

The dispatch order time card is issued in duplicate, the original in white, Fig. 10, and the duplicate on a buff card, Fig. 11. It will be seen that the original, Fig. 10, has provision for inspectors' reports under the headings "Deliveries" and "Spoiled" in place of the space on the buff card, Fig. 11, for the stamping of starting and stopping times by a clock recorder. These cards—the productive material requisition in duplicate, the routing card, and the dispatch order time card, also in duplicate, are then clipped together and placed in a clip on the dispatch board.

The dispatch board is the center from which the orders for material and the shop orders are dispatched, and also the center from which the machining of the work is controlled. Divisions are made on the board for each work station, properly indicated by number, and all work either about to be made or in process of manufacture, is relegated to this section of the board. This is in charge of the dispatcher, and his duties are primarily to maintain a systematic steady flow of operations, and prevent the occurrence of idle machine time. Under each machine division on the dispatch board there are three wire clips which are designated as "jobs planned," "next job," and "jobs done." The dispatch order time cards, with the routing card and productive material requisitions attached, are then filed in a "to do" file at the dispatcher's desk, and this file is drawn from as jobs are placed on the dispatch board.

PART NO. | ORDER NO. | LOT NO
PART DESC.
QUANTITY OF ENTIRE LOT
QUANTITY OF THIS LOT
QUANTITY IN THIS BOX
THIS BOX NO
NO. OF BOXES TO THIS LOT
TAKEN FROM BOX NO.

ROUTINE: DEPT. | OPERN | MCH NO.

DELIVERIES: DATE | QTY | BOX NO. | AT OP'N

Routing Card
HOPEDALE MFG. CO.
MILFORD, MASS.
H. M. CO. FORM L. V. E. 123

Fig. 9. Routing Card which accompanies the Material through the Plant

Dispatch Board Routine

As time goes on, the dispatch order time cards are advanced to the "jobs planned" clip for the machine on which it is desired to perform the work, but before this is done the original copy of the dispatch order time card is placed in a "jobs working" file on the timekeeper's desk where it is filed numerically. This original (Fig. 10) will later carry the inspector's reports and will furnish the information (after the completion of a job) for the control board operator to indicate the flow on the material and flow board. After a job has been completed, the dispatch order time card is placed in the "next job" clip. When the dispatch order time cards reach the "next job" clip, the dispatcher removes the material requisition, Fig. 8, and the routing card, Fig. 9, and forwards both to the storekeeper. The operator's clock number and name are then entered on the buff dispatch order time card, Fig. 11, which is then placed under the "next job" clip.

As soon as the storekeeper has received the material requisitions and routing card, it is his duty to forward the material to the machine designated, together with the routing card, and send the duplicate copy of the material requisition to the production department, retaining the original

DELIVERIES: DATE | QUANTITY
SPOILED: DATE | QUANTITY
TO START: DAY | HR. | MIN.
CHECK ✓ LAST CARD HERE | CHECK ✓ FIRST CARD HERE | ORIGINAL | CONTINUATION | RE-OPERATION

DEPT.
QTY. OF THIS LOT
QTY. MADE TODAY
BAL. TO DO OF THIS LOT
STANDARD TIME: HRS. | MINS.
ACTUAL TIME: HRS. | MINS.

MACH. NO. | CLOCK NO.
EMPL. NAME
OPERATION
NO. OF BOXES | BOX NO. | OPER'N NO.
PART DESC.
ACCT. NO. | ORDER NO. | LOT. NO.

HOPEDALE MFG. CO. — **DISPATCH ORDER TIME CARD** — MILFORD, MASS.
H. M. Co. Form L. V. E. 122A

Fig. 10. Original Dispatch Order Time Card with Provision for Inspector's Report at the Left

for his own files. It is of course necessary to so organize the trucking department that the material will be delivered as designated on the routing card.

When an operator is ready for a new job he goes to the dispatch board, removes the buff card, Fig. 11, from the "next job" clip, stamps the starting time on it, and then proceeds to his work, retaining the card until after the operation has been finished, or until the end of the day, when all dispatch order time cards have to be turned in. Upon reaching his machine, the operator should find the material already delivered from the storekeeper. After the operation has been finished, or at the end of the day, the operator enters on the card the quantity made, and the balance to be made, and stamps the stopping time on the card, placing the card in the "jobs done" clip and taking a card from the "next job" clip. He then proceeds with the second job as before.

As soon as the card appears in the "jobs done" clip it is a notice to the dispatcher and trucking department that material is ready for transfer from a particular machine. The truckers then remove these cards, drop them into a box provided for the purpose at the dispatch board, and proceed to make the transfer of material. In making the transfer,

CLOCK RECORD: STOP | START | TIME
BURDEN NO. | BURDEN RATE | BURDEN AMT.
TOTAL EARNED | RATE | TOTAL TIME

TO START: DAY | HR. | MIN.
CHECK ✓ LAST CARD HERE | CHECK ✓ FIRST CARD HERE | ORIGINAL | CONTINUATION | RE-OPERATION

DEPT.
QTY. OF THIS LOT
QTY. MADE TODAY
BAL. TO DO OF THIS LOT
STANDARD TIME: HRS. | MINS.
ACTUAL TIME: HRS. | MINS.

MACH. NO. | CLOCK NO.
EMPL. NAME
OPERATION
NO. OF BOXES | BOX NO. | OPER'N NO.
PART DESC.
ACCT. NO. | ORDER NO. | LOT. NO.

HOPEDALE MFG. CO. — **DISPATCH ORDER TIME CARD** — MILFORD, MASS.
H. M. Co. Form L. V. E. 122B

Fig. 11. Duplicate Form of Dispatch Order Time Card with Spaces for Time Recorder Stamp

DELIVERY
TIME RETURNED
DATE | TIME
RECEIVED BY

MATERIAL CREDIT REQUISITION
HOPEDALE MFG. CO.
MILFORD, MASS.

STORESKEEPER: THE FOLLOWING MATERIAL HAS BEEN RETURNED FOR CREDIT. FORWARD THIS REQUISITION TO PRODUCTION DEPT. AT ONCE.

IDENTIFICATION
LOT NO.
ORDER NO.
ACCOUNT NO.
PART NO

RETURNED BY
RETURNED FROM
RETURNED TO ROUGH FINISHED STOCK
REASON FOR RETURN

QUANTITY RETURNED	QUANTITY RECEIVED	COMPLETE DESCRIPTION OF MATERIAL	PRICE AMT.	PRICE PER	AMOUNT	

H. M. CO. FORM L.V.E. 128

Fig. 12. A Material Credit Requisition used when returning Overdrawn Material to Stock

DELIVERY
TIME TO DELIVER
DATE | TIME
ACTUALLY DELIVERED
DATE | TIME
DEL'R TO
DEPT.
LOCATION

NON-PRODUCTIVE MATERIAL REQUISITION
HOPEDALE MFG. CO.
MILFORD, MASS.

STORESKEEPER: FURNISH MATERIAL AS SPECIFIED. STATE AMOUNT AND TIME DELIVERED, AND SEND THIS REQUISITION TO PRODUCTION DEPT. AT ONCE.

MATERIAL IS TO BE USED FOR

IDENTIFICATION
ACCOUNT NO.
ORDER NO.
ORIGINAL
CONTINUATION
RE-OPERATION

QUANTITY REQ'D	QUANTITY DEL'D	BAL. TO DEL.	DESCRIPTION OF MATERIAL	PRICE AMT.	PRICE PER	AMOUNT

H. M. CO. FORM L. V. E. 129

Fig. 13. Requisition for Material used for other Purposes than for Regular Manufacture

the routing card, which has remained with the lot, furnishes the information for routing the material. If it so happens that a job is not finished at the end of the day, the time card is placed in a box on the timekeeper's desk, and the timekeeper will then issue a new dispatch order time card (in a different color). When the operator starts the job again the next morning, he will find the new card properly located in the "next job" clip, where it has been placed by the timekeeper the night before.

After the dispatch order time cards have been made use of by the timekeeper they are forwarded to the payroll department for computing the operator's wages. The information which the timekeeper obtains from the dispatch order time cards is arranged in report form and delivered to the production department every morning. It is this report to which the control board operator refers when indicating the flow of finished work. As previously stated, the flow of rough material (that is, its receipt from the foundry) is obtained daily from foundry reports.

It will be seen that if this procedure of reporting every morning to the production control center is followed in each department in the plant, complete information will be obtained of exactly what is happening throughout the entire plant, and this can best be shown by the use of charts.

Load Board Routine

On the morning of June 25 the production report for the 24th is delivered to the control board operator, showing that Operation 1 on the friction collars was completed on 120 units; this is accordingly shown graphically in red on the control board to the right of the starting hour, 11 A. M., and opposite machine 127. This report carries also the number of spoiled parts, as determined from the inspector's report entered on the original of the dispatch order time card, Fig. 10. There were ten defective collars on June 24, and this is indicated by a green line, the amount being written directly above it (Fig. 7). Below the red line the notation 120 $\pm$ 0 is made, which means that 120 collars were produced with no excess or under production. On the morning of the 26th the report for the preceding day shows that work did not start at 7 A. M., due either to absence or tardiness of the operator. When such a condition exists, the failure to start is immediately noticed by the departmental foreman, who then notifies the production department that work has been held up on machine 127, giving the reason therefor. This fact is immediately indicated on the load board in the form of a red and blue bulls-eye, located at the gap where the interrupted production occurs.

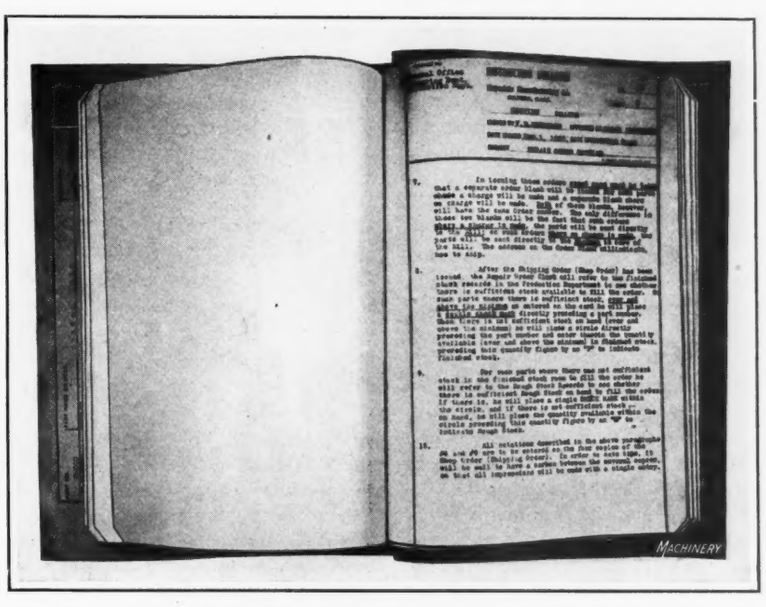


Fig. 14. Inspection Bulletins bound in Loose-leaf Form

The next day's report shows that production was resumed on the machine at 8 o'clock and that 180 units were machined on the 25th, this being indicated as shown, with the space left indicating the idle machine time. The production of 180 is then added to the preceding day's production and the notation 300 — 20 is entered as shown, to indicate that the 300 figure is 20 below the estimated production for the two days. The daily report for the 26th, which was received on the morning of the 28th, shows that 100 units were turned out, which is 20 in excess of the schedule requirements for that period of time. In charting this production, the excess 20 units is indicated by extending the line to the left of the space provided for the 26th of the month, so that it overlaps the preceding day's production. The accumulated total is 400 $\pm$ 0.

Although the entire lot of 400 has been turned out within the scheduled time, it is seen that there are ten defective pieces, leaving a balance of 390 perfect castings. This shortage can be conveniently handled by drawing on the reserve, or ten additional units can be made. In the latter case, the dispatch order time card will have indicated on it in the upper right-hand corner (see Figs. 10 and 11) that this is a reoperation job.

The remaining operations are indicated graphically in a similar manner, and above each graphic representation there is entered a notation giving the order number, part number, operation number, machine or work station to which the next operation passes, and the required daily production.

The control board operator is thus furnished with the information which will enable him to inform the production manager regarding all cases where failure to meet the production rate has occurred. A daily report issued to the production supervisor by the control board operator shows definitely the extent and seriousness of any falling behind in produc-

tion, and enables immediate steps to be taken to remedy the trouble. The red and blue bulls-eye on the load board focusses attention upon any stoppage of production.

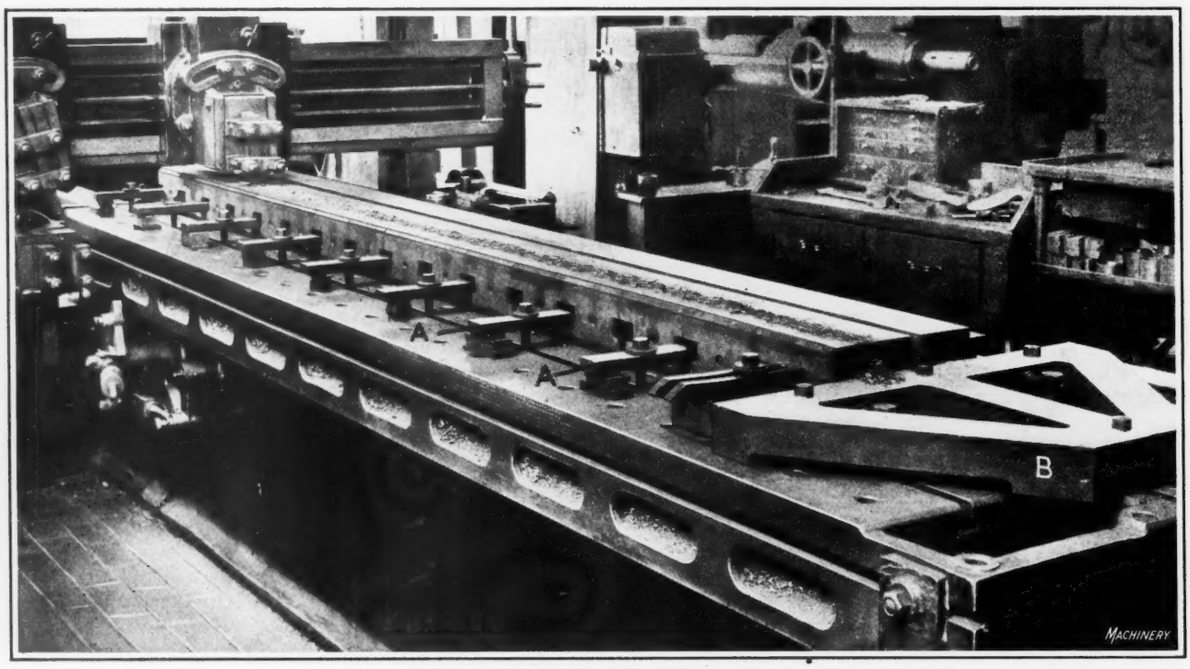
Measures for Preventing Haphazard Methods

It will be realized that in addition to the few forms which have been shown in this article, numerous other cards and requisitions are required in order to take care of exigencies that arise in the functioning of the system. For example, there is the material credit requisition, Fig. 12, which is sent to the storekeeper whenever material is to be returned to storage, enabling the stock records to be readjusted. Such a condition is frequently encountered when material has been withdrawn from storage and charged to a non-productive job. A non-productive material requisition, such as that illustrated in Fig. 13, must be issued for the withdrawal of stock which is to be used for non-productive purposes, such as repairing and general mill-wrighting. A definite knowledge of all material which goes into any branch of the industry, be it productive or non-productive, must be under the control of the production department. There is also the issuance of non-productive time cards for such workers as truckers, stock-room men, house electricians and carpenters, millwrights, oilers, watchmen, etc.; and further, the readjustment of ratings, the handling of repair orders, the issuance of foundry orders, and the routine connected with the control of stock within the stock-rooms.

These several auxiliary parts of the system are all correlated, and must each be definitely taken care of. When the graphic control system was installed, these facts were fully appreciated, so that it became at once apparent that some definite clearly defined routine would be necessary. Consequently all correspondence from the heads of the various departments and the executives relating to any phase of production is required to be handled in the form of instruction bulletins. These instruction bulletins have been issued on every phase of the system, and have to do with all internal house routine. They are neatly prepared and bound in loose-leaf form, as shown in Fig. 14. It will be seen that copies of these instruction bulletins go to all departments concerned in the issuance of any instructions. These instruction bulletins are numbered and carry at the head the subject and the names of those responsible for the issuance of the bulletin, together with the current date and the date effective. Written instructions are insisted upon.

PLANING CROSS-SLIDES FOR NATIONAL-ACME AUTOMATICS

On automatic screw machines built by the National Acme Co., of Cleveland, Ohio, the cross-slide for the forming side of the machine is required to interchange with the cross-slide on the cut-off side. To insure this interchangeability, a high degree of accuracy must be attained in the performance of the planing operations on these castings. The accompanying illustration shows a string of the forming slides on which a T-slot is being planed, and the particular point of interest in connection with this job is the method of setting up the work. In addition to applying the multiple set-up principle, which enables a substantial increase to be attained in the rate of production, it will be seen that advantage is taken of the fact that each slide has been undercut at both sides to afford the necessary means of supporting it on the machine. As the castings are set up for planing, these under-cuts come together, forming the equivalent of a T-slot into which the end of straps *A* may be inserted in such a way that each strap grips both of the shoulders on two castings and holds them firmly in place. End thrust is taken by a stop *B*, which is carefully finished to engage the finish-planed end of the first piece of work, thus substantially assisting in the set-up, by forming a reference point from which to start to align the string of castings with the line of travel of the planer table.



Multiple Set-up used in planing the T-slots in Cross-slides

* * *

COST REDUCTION A FACTOR IN THE FUTURE OF THE AUTOMOBILE INDUSTRY

In a comprehensive study of the automobile industry and its future, made by Leonard P. Ayres, vice-president of the Cleveland Trust Co., Cleveland, Ohio, the conclusion is drawn that extensive price adjustments will be made in that industry in the next few years, and this conclusion, if accurate, makes it inevitable that the automobile business will finally be concentrated into fewer competing hands and curtailed more than it is now. For a long time to come the machine tool market offered by the automobile industry will not be on the same basis as it was in the past, during the great development of the industry. The survival of the concerns now in the automobile field will depend upon their ability to reduce costs of production; that means that there should be a market for machine tools of high productivity.

Economic Value of Factory Investigations

By ALBERT A. DOWD, President, and FRANK W. CURTIS, Chief Engineer, Dowd Engineering Co., New York City

A FEW plants are taking advantage of the present dull period to overhaul their equipment and make improvements here and there in their methods of handling work and materials, thus taking a step in the right direction in their preparation for future business. It is the progressive man who realizes that something of this sort is necessary. Others will continue with obsolete machine tools or those that need overhauling, and will wait until business really improves to such an extent that they will need their equipment before they spend any money in preparation work. This attitude simply means that they are not far-sighted, and will get skim-milk while their more progressive competitors take the cream. Methods and tool equipment should both be considered in any planning for future work, and those who are doing this preparatory work now will be rewarded when business improves, for they will then be ready to operate and make early deliveries.

Matters of this sort are of vital interest to every manufacturer in planning for future business, and there are a number of points that he must consider with care. The labor problem is one; the question of salaries for office workers and wages in the factory must be given consideration. The conditions under which the men will work, together with such things as heating, lighting, ventilation, and the sanitary provisions for the workmen's comfort should be looked into. Now is the time to think of these matters in a broad-minded way, and at the same time to put into operation some of the ideas for improvement that may be suggested by past experience. It is no time to be idle and to say that one cannot afford to waste money by doing any of these things now when there is no business. It is really the opportune time to do preparatory work.

The Value of Outside Perspective

The majority of manufacturing plants need a certain amount of reorganization at the present time, largely on account of the changes which have taken place in business conditions in the last few years, especially the changes that the last year has brought about. The reorganization which is required may be either radical or moderate. If the factory has been greatly enlarged and many departments added to handle other kinds of work than those for which the factory was originally intended, it is necessary to look over the equipment carefully and see for what class of work it is best suited, and then make an attempt to obtain or manufacture work of this class.

Investigation of the factory by an outside engineer, together with an analysis of matters as he finds them, has been found to be of great value at this time. Ordinarily the executive says: "I know my own plant best. No one can tell me how to operate it, as I know every machine in it." It does not always follow, because an executive feels this way about it, that the statement is really accurate. The outside engineer, if he is a capable man with sufficient mechanical experience, can look over a factory and see many things in it which would be entirely overlooked by the executive who might be familiar with all of them, yet underestimate their importance. The outsider brings an open mind into the situation, and is therefore impressed by things as he finds them, and not by matters as he expects to find them, as may be the case with the executive familiar with the conditions. Largely for this reason, the investigating engineer is able to look at the matter without being influenced by anything except the conditions as he finds them, and as a consequence his report is of great value on account of its freedom from restraining influences.

Such an investigation at the present time may seem, at first, an unwarranted expense which will not be likely to produce any immediate results. So-called "efficiency experts" are not always expert, nor do the results achieved meet the expectations. But there are consulting engineers who know their business, and the executive can investigate before he engages a man.

The Investigator and His Work

A consulting engineer can be brought in from outside for one day a week, or two days a month. All he does is to go through the various departments, noting conditions and making a report on them with suggestions, at a cost that is not excessive. The total cost may run to from $1200 to $2400 a year. It is quite possible that with an arrangement of this kind great savings may be effected in the methods of manufacture, provided the man selected for the work has had sufficient experience to enable him to analyze conditions as he finds them and suggest improvements where needed.

Some executives consider it more or less of an insult if any suggestion is made by a director or stockholder of the company regarding an investigation of the methods used. As a matter of fact, this attitude is a mistaken one, because a capable executive should welcome any assistance either from the inside or outside which will tend to reduce production costs. Instead, therefore, of being antagonistic to the idea, he should give careful thought to the subject and look at the matter in an open-minded way. As an executive, he should certainly welcome any suggestion which would show him how to increase his production from 10 to 25 per cent without adding to the production cost, or, what is the same thing, to reduce costs a corresponding amount without reducing production. In looking into the matter, therefore, let us see how the investigator works and how he obtains his results, keeping always in mind the fact that the outside viewpoint enables the engineer to look at a thing fairly as well as analytically.

Cost Reductions Resulting from Factory Investigations

Let us take two or three specific examples of savings which have been effected by the suggestions of an outside investigator in factory work. A small spur gear, approximately 2 inches in diameter by 3/16 inch thick, had been made for some years from a steel blank, bored, reamed, the keyway cut, faced, and finally teeth cut on a gear-cutter. A method suggested to replace this was the use of punches and dies, the work being turned out in this way in somewhat less than half the time formerly required. The work was also held within very close limits of accuracy by the use of shaving dies. The number of machines required was reduced and their cost was much less than that of the types formerly used. The old method gave a production of 1200 per day and utilized five machines for the purpose, namely, one screw machine, two engine lathes, one broaching machine, and one gear-cutter. The new method gave a production of 2600 per day with four punch presses. These machines are much cheaper than those used in the other operations, and it will be seen that the actual saving in time

was more than 50 per cent. The cost of dies was somewhat more than the tool equipment previously used, but this extra cost was soon absorbed by the savings effected.

Another revision of methods which brought about extensive savings was that of a small shouldered stud 1¼ inches in diameter by 2½ inches long, which was formerly made on an automatic screw machine. This method required considerable forming and a slow cutting-off operation. The production obtained was 120 pieces per day. By making this part in the form of a drop-forging and handling it by another method consisting of short simple operations on the drilling machine and engine lathe, respectively, a production of 200 pieces per day was found to be easily possible. In addition to this, the new method did not waste as much material as the old so that there was a saving in this regard also.

Improved Method of Manufacturing a Long Rod

Another factory had as an important item in its manufacturing schedule, a rod 48 inches long by ½ inch in diameter having a head on one end with a ½-inch hole drilled through it. The old method of manufacturing this unit was to bulldoze the end of the rod to flatten it out, and after this to mill both sides of it and drill a hole. The operation of bulldozing was not so very slow, but the work was awkward to handle in the subsequent operations of milling and drilling, thus making a very slow method of handling. In the improved method the end of the rod was made in a punch press from ⅜-inch flat stock, blanked and pierced with the hole required. After this operation, this end was welded to a rod cut off to the proper length. The only thing then remaining to be done was to dress off the fin at the joint where the work was welded. The new method gave a production more than double that obtained by the old process.

These examples are given specifically in order to show the opportunities for improvement which may be brought about by a wide-awake man in the investigation of methods in the factory. A number of other important matters not directly connected with the machining of the work are also subjects for analysis. Several of these points are mentioned in the following in order to show the scope of a thorough factory investigation.

Handling Materials

There are very few factories where the material is handled with maximum efficiency. Work is often piled up where it is in the way of both operators and trucks. Simple conveyors which often may be gravity-operated, together with suitable racks and stands for placing the work so that it can be conveniently handled, are always of assistance in carrying the material through the factory without waste of time. The investigating engineer studies the requirements and determines how the work, both raw material and finished product, can be most conveniently arranged and carried from one department to another.

Inspection and Salvage

The inspection of the raw material and the finished product are important factors in production. Much unnecessary work may be done in the machine shop due to a careless method of inspecting the raw material. Defective castings may be put through and machined, with the result that they will be scrapped before or after completion. The study of these matters is often the means of saving considerable money. Work that goes through the factory and does not pass inspection on account of errors in machining may often be salvaged in one way or another, so that the material and the time expended in the manufacture are not totally lost. Much depends upon the nature of the work as to how it may best be adapted or refinished to suit some other condition. A hole which is bored over size in a casting may be again bored and the hole fitted with a bushing of the correct size in order to save the piece. Many other opportunities are found by the careful investigator, which reduces the amount of work scrapped to a minimum.

Many products require painting or japanning in order to give them a certain finish after the machining work has been done. The methods used for the process of painting are often very wasteful, both of time and paint. A process of spraying may be found economical for the application of paint in connection with suitable dryers and conveyors. In japanning, the work may be automatically dipped and carried through the baking ovens by means of conveyors. By thus considering each process, the investigating engineer can suggest economies not always apparent to the owners.

Definite reductions in costs have been shown to result from factory investigations. In one case a production of 1200 small spur gears per day was increased to 2600 per day, and a less expensive machine tool equipment was used for the greater production. In another case a production of 120 shouldered studs per day was increased to 200 pieces per day by a change in the machining methods; and in still another case production was doubled by making a part in two pieces and welding them together, instead of making it entirely from one piece as had formerly been done. Next month additional examples of cost reduction by increased production through the use of improved methods will be given in another article by Mr. Dowd and Mr. Curtis.

Time Studies

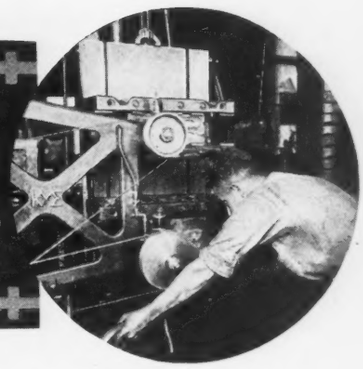
Time studies showing the length of time necessary to perform this or that operation are often not favored by the shop executive because they may be objected to by the shop men. It is possible, however, to institute such a system for this purpose that no trouble will be caused. In the establishment of piece-work prices, time studies are an important factor in determining a price which will be fair to manufacturer and operator alike. The matter of speeds and feeds for the various machines is an extremely important matter and it is safe to say that a large part of the losses in production in the average factory are the result of incorrect feeds and speeds.

Assembling

The assembly department often presents to the investigator many problems for solution. A great deal of labor is wasted by inefficient methods, and there is more hand fitting than there should be. Time saved in the final fitting of parts which are to be assembled is an important item of manufacturing, and the cost of the product is often greatly reduced by efficient work in the assembly department. The process of gaging and the limits used have a pronounced effect on assembling. If allowances and tolerances are not correctly determined in the first place, the final assembly is much hampered, and considerable extra fitting becomes necessary. This part of investigation work requires diplomatic treatment and a careful analysis.

The various points mentioned in this article are intended only to give an executive a general idea regarding the value of an investigation of his factory by an outside engineer. No attempt has been made to go into detail regarding the various methods used by the investigator, although it will be realized that a certain amount of diplomacy is necessary in order to avoid conflict with foremen and operators. Much of the work mentioned can be done by a comparatively rapid survey, but many results of value can be obtained only by a careful and logical analysis of conditions as found, resulting in suggestions for improvements in methods which do not appear to be as efficient as they might be. The belief that present-day practice is not susceptible of improvement is often the reason for high production costs.

Design and Making of Drop-forging Dies



Methods of Heating, Quenching, and Drawing Carbon and Alloy Steel Dies

IN August and September MACHINERY the design of dies and modern diemaking methods were described. The present article on drop-forging dies deals with the heat-treatment. It was stated in August MACHINERY that the blocks when received from the steel mill are usually in the annealed state; but sometimes they are so heat-treated that they do not require any further heat-treatment and are put into immediate service after the impressions have been sunk. The types of dies which are heat-treated at the steel mill are those that are unusually large or those alloy steel blocks that demand in their heat-treatment certain methods which the steel manufacturer is better equipped to use than is the die manufacturer. The scleroscope reading of these heat-treated die-blocks ranges from 40 to 50, which is the limit for machineability, under ordinary circumstances. The present article deals almost entirely with the heat-treatment which annealed untreated blocks require after the die impressions have been sunk.

Heating for Hardening

After the impressions have been sunk, the annealed blocks should be heated in the following manner preparatory to quenching for hardening: The blocks should be allowed to heat gradually, absorbing the heat already in the furnace from the previous run, before the heat is again turned on. The initial temperature of the furnace should not be more than 600 degrees F., and if care is not exercised in permitting the blocks to become thoroughly permeated with the low furnace heat, rupture is likely to occur, because it is during the low temperature changes that the most trouble in this respect is encountered.

Before placing the dies in the furnace, they should be set, face down, in a shallow iron box or tray, the bottom of which has been previously covered with powdered charcoal, or spent bone. The tray should have projecting lugs, to accommodate the arms of the truck used in transporting the loaded tray in and out of the furnace. When it is necessary to harden unusually large die-blocks, it may be impracticable to use a pan, and in such cases the blocks are set directly on the furnace hearth, shank down in order to facilitate handling them, the truck arms straddling the die shank and extending under the die when it is being moved. The faces of the dies should be covered with a thin layer of powdered charcoal, held in place by a suitable iron plate. This precaution prevents the formation of scale and the decarburization of the impression surfaces.

After placing the dies in the furnace, the temperature is raised steadily to from 1375 to 1500 degrees F., and the blocks are permitted to remain in this heat until all dark spots have disappeared. Although the heat-treater is governed considerably by experience, in judging the time for leaving the blocks in the furnace, the appearance of the red-hot block furnishes a more definite indication of the proper withdrawal time. A 12-inch cube of steel will heat thoroughly, starting from a furnace temperature of 600 degrees F., in about seven hours, and other sized blocks in proportion.

The furnace, which for convenience should be located near the die-sinking department, should preferably be of the under-fired semi-muffle type, although there are a number of standard furnaces on the market which are designed especially for handling this kind of work. Excellent results have been obtained from specially designed furnaces, burning either gas or oil, constructed with a high arch and with provision for conducting the heat to the die by radiation rather than by direct contact.

Quenching

Carbon steel blocks may be quenched for hardening either in water or oil. All dies should be quenched immediately from the hardening heat (1375 to 1500 degrees F.). Good results will be obtained if the blocks are permitted to become only partly cooled in the bath, so that when withdrawn a finger can be held in the deepest impression for several seconds, after which the blocks may be immediately drawn on a hot plate, before the dies have had time to cool completely. Of course, if the blocks are completely cooled in the quenching bath, they may be drawn to the correct hardness by reheating in a furnace or oil bath, and quenching. The recommended tempering heat for the steel (about 450 degrees F.) should be employed.

If the blocks are massive and are hardened in water, a quenching tank should be employed which can accommodate a plentiful supply of circulated water. The blocks should be dipped face downward to a depth which will bring the deepest impression about an inch below the surface of the water. The tanks should be equipped with means for spraying water against the die face, to prevent steam pockets and uneven shrinkage.

The proper heat-treatment of drop-forging dies is perhaps one of the most important steps in the economical operation of a drop-forging plant, for nearly all other economies may be nullified by improper heat-treatment. On the one hand, careless handling in the heat-treatment may spoil the dies and cause a waste not only of the material from which they are made, but of all the labor that has been put into the sinking of the impressions. On the other hand, even though the dies may pass from the hardening room in what may appear to be first-class condition, if they are not of the right hardness and toughness, they will not stand up under the hammers anywhere nearly as long as if correctly treated, and as a result the cost of dies will increase rapidly. Too much attention cannot be paid to the heat-treating department in any plant, and this is especially true in a drop-forging plant where dies are hardened and drawn; hence, the emphasis laid on this subject.

If the face of the block is approximately square, a 2-inch outlet for this stream will be about right. If the block is long, the stream should be so distributed that it will extend at least the full length of the block. While the die is being quenched in this manner, the shank should be cooled by playing a stream of water on it as a means of preventing distortion, and this stream may be so manipulated as to keep the shank level. As the face cools, the amount of water applied to the shank should be gradually diminished. By this method the amount of distortion can be controlled so that the shank will not be out of level more than 1/32 inch on a large die. These precautions are not required when oil is used as a quenching medium. Any convenient means may be employed for suspending the dies, but if they are heavy and awkward to handle a cradle is sometimes employed, attached to the side of the tank, which may be adjusted to hold the block at the proper height relative to the surface of the liquid.

The die may be ruined in quenching, especially when water is used; consequently this work should be carefully performed, and should be entrusted to no one but a man who has had extensive experience in hardening dies. If the die impression is at all intricate and has sharp corners and edges, these should first be "checked" with a piece of water-soaked waste or a piece of soap. The shank should be dipped long enough to chill it, and the die then turned over and quenched, face down. Water should be splashed on the sides of the die while the face is cooling in the water.

Although water is generally used for hardening when carbon steel dies are being quenched, oil is often used for dies that do not require such a degree of hardness as is obtainable with water. In quenching alloy steel dies, oil should always be used in preference to water. Oil will produce less distortion and cause less risk of breakage than water. The oil should be circulated through coils in the tank and maintained at a temperature of about 100 degrees F. In quenching alloy steel blocks, they are entirely submerged, face downward, until they are covered to a depth of 12 inches. The blocks should be kept in motion and remain in the quenching oil until they have cooled to a temperature of 300 degrees F., when they are drawn. The determination of this temperature may be obtained by the use of a thermometer or by applying tin-lead alloy shavings, which melt at a temperature slightly above that required for withdrawing the block.

Drawing the Temper

All die-blocks should be drawn immediately to a hardness of from 50 to 80 scleroscope, the exact hardness depending on the work to be done, the nature of the impression and the material the dies are made from. Oftentimes, the hardness requirements are determined solely by the hardener's personal experience and judgment, so varied are the factors to be considered. Under no conditions should dies be allowed to lie on the floor after heating, as they are likely to become injured or accumulate a coating of rust before being drawn. Practice regarding the drawing of die-blocks varies in different shops, and is influenced considerably by the size of the block. In one shop where all blocks are drawn back in a furnace, they are permitted to cool completely in the quenching bath, and are then drawn at a temperature of from 400 to 500 degrees F. for a period of about three and one-half hours and allowed to cool in the furnace. It has been found that this procedure will give the desired scleroscope reading for the particular kind of steel used.

If the die-blocks are drawn before they are permitted to cool completely, as mentioned in an earlier paragraph, excellent results will be obtained without the use of a furnace. The method used for small and medium-sized carbon steel blocks is to place the blocks, still very warm, shank downward on a hot iron drawing plate, leaving the impression in full view, and permitting scleroscope readings to be taken from time to time as the color indicates the approach to the proper hardness. The drawing plate may be heated by placing it on a gas or oil-fired brick oven, or by any other convenient means. Readings should be taken in several places, the surfaces being wire-brushed before the readings are taken. An allowance should be made of from three to five scleroscope numbers for the steel to gain in hardness during cooling. This amount will be governed somewhat by the size and shape of the die and the kind of steel from which the block is made. As soon as the desired hardness is obtained, which will be after the die impression becomes blue, the die is removed from the plate and the draw checked by pouring oil in the die impression.

The following modification of the treatment frequently used, will give excellent results for large annealed carbon steel die-blocks, this being the only heating that the dies receive. After heating, quench the dies, face downward, all over for a few seconds in circulating water; then raise until the face is submerged about 3 inches, keeping a spray of water, which rises from within the tank, in contact with the face of the die for about 1½ minutes. The shank will then show a dull red, caused by the heat radiated from the center of the block, which has been reduced but slightly by the quenching. In drawing alloy steel blocks without using a furnace, they should be quenched all over in oil to reduce the red exterior heat to a dull red color. The dies, whether carbon or alloy steel, are then set shank down on the floor and permitted to cool gradually. It is during this cooling period that the refinement and drawing back of the face occurs. The heat for drawing the temper is that retained in the center of the die.

Records of Heat-treatments

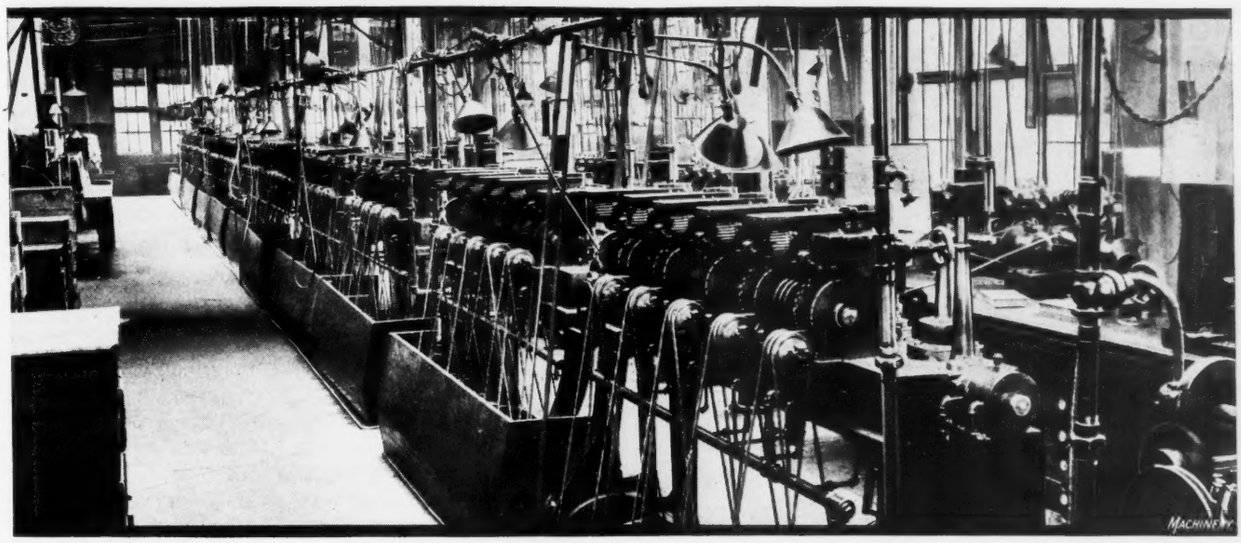
The following detail connected with the hardening of dies is followed by a large drop-forging concern located in the Pittsburg district. The dies are numbered and a card index file is kept, by means of which there are recorded the length of service of the die before it is necessary to resink the impressions, and its entire history as regards the nature of the work produced and the number of forgings received from the impression. This is an excellent check on the hardening process, and may be used to good advantage to so modify or alter the hardening procedure that failures rarely reoccur on the same type of die-blocks. In this way, if any question as to the proper heat to use or any data relative to quenching should arise, the correct method may be determined by reference to the record of similar cases.

The actual production of drop-forgings will be dealt with in a later article of this series, which will appear in November MACHINERY, in which a description will be given of the method of drop-forging different classes of work. The information contained in this series of articles has been furnished mainly by the J. H. Williams Co., Brooklyn, N. Y., and the Union Switch & Signal Co., Swissvale, Pa.

* * *

BRITISH ENGINEERING STANDARDS ASSOCIATION

At the annual meeting of the British Engineering Standards Association recently held in London, the annual report presented reviewed the work of the association. There are now more than 1500 engineers who give their time and experience to this important work in Great Britain, often at great personal expense and inconvenience. While engineers generally have taken the keenest interest in the various problems submitted to the association, business men, it was stated, have not been as thoroughly impressed as they should be with the commercial value of standardization. Last year about $60,000 was expended on this work, of which the industry of Great Britain contributed about $40,000, the remainder being government grants. The various national standardization committees are assisting the trend of international agreement in engineering matters, as far as practicable.



Automatic Machines in a Watch Factory

Machines, Devices, and Methods Employed in the Plant of the Waltham Watch Co., Waltham, Mass.—Third of a Series of Articles

THE automatic machines described in the first two articles of this series (see August and September MACHINERY) are used in performing the various machining operations on pillar plates, barrel and train bridges, and balance cocks, which enter into the construction of a watch. A number of additional ingeniously constructed automatic machines are described in the present article.

Pinion-making Machine

One of the interesting machines is that used for producing the various pinions of a watch complete from bar stock. Some of these pinions are so small that a piece of dough is used to pick them up, and they are removed from the dough by tweezers. It is interesting to note that these tiny pinions are in most cases machined with two cuts for each surface—a roughing and a finishing cut—just as in machining larger work.

A view of the top of the pinion-making machine is shown in Fig. 15. Each pinion has a number of leaves (or more properly, teeth) and this machine also cuts these leaves. The end of the stock can just be seen at *A* projecting from the chuck. The chuck which holds the work is air-operated, and can be advanced or receded to carry the work under the cutters which mill the leaves and to return it for the beginning of the next cut. The circular cutting tools, of which there are nine, are carried in a circular cutter-head. The cutter-head is indexed by means of a ratchet, located at the center of the cutter-head spindle and covered by a guard. The ratchet indexing mechanism carries a retainer pawl for locating the cutter positively, when the cutter-head is indexed. A set of individual stops provides for setting each tool after grinding, so that in relocating the tools, the previous position of each will be maintained. The collar which carries the set of stops is indicated at *B*.

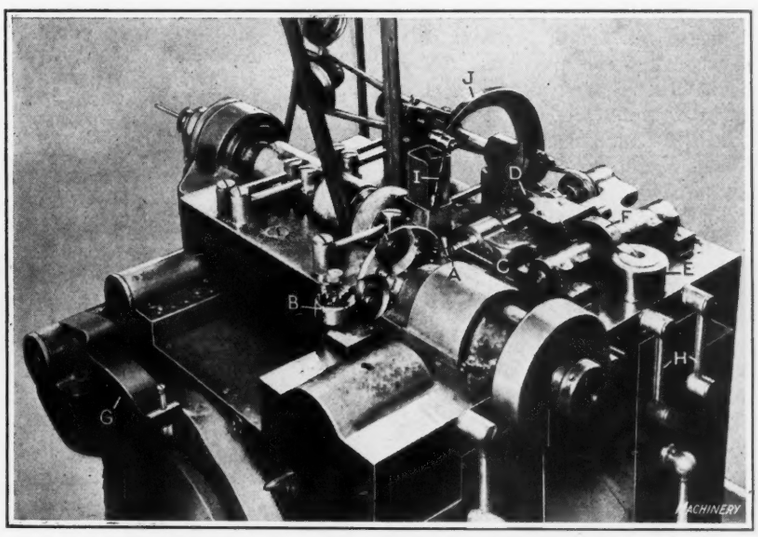


Fig. 15. Automatic Pinion-making Machine, with Air and Cam Controls

Two cuts are taken in machining the teeth in a pinion, a slitting saw and a forming cutter being carried on one cutter-spindle *C*, with provision for proper location of each, this being determined by the feed movement of the slide on which the cutter-spindle arm *D* is carried. These milling cutters are fed down by air pressure exerted through the cylinder *E* and the finger *F*, and the cutters are raised by a spring to permit indexing of the work preparatory to taking the next cut. The index mechanism is a ratchet device which operates when the air countershaft is reversed, during which time the driving belt slips on the pulley. The cam shown at the front of the machine actuates lever *G* to advance and recede the work during the machining of each pinion. There is another cam in back of the spindle-feed cam which controls the operation of the cutter-head slide by the regulation of the air valves by means of which this movement is actuated

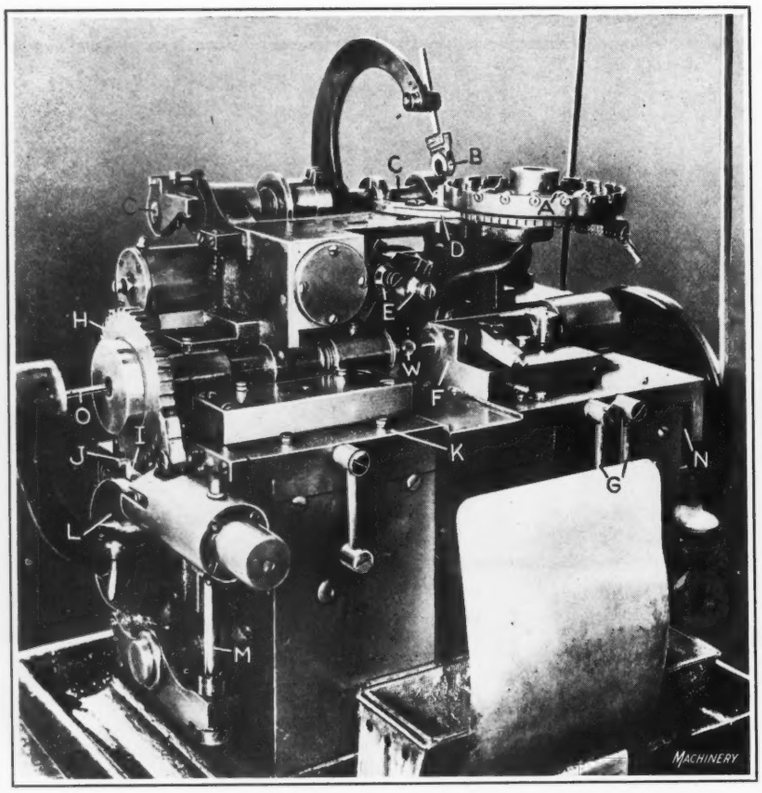


Fig. 16. Automatic Machine in which the Teeth are cut in Steel Wheels or Pinions

The air connections which deliver the air directly to the slide are shown at *H;* similar air delivery tubes are also shown at the opposite end of the machine.

A wire clip *I* picks up each piece as it is being cut off, and this clip is swung into position by an air valve which controls the movement of the shaft to which the over-arm *J* is attached. As soon as the pinion has been severed and picked up and the arm has been raised to the elevation shown, the shaft is given a quick longitudinal movement which results in snapping the pinion from the clip, and letting it drop into a receptacle. The work which this machine produces must be accurate to a very high degree, because the ends of the pinion staff pivot in the jewels or bushings of the watch, and the limits of manufacture allow no variation in size, although it is, of course, necessary to select the jewel bearings so that the holes will receive each pivot properly.

Steel Wheel Cutting Machine

A machine which cuts the teeth in steel wheels, or gears, for watches is illustrated in Fig. 16. Ten or twelve of these wheels are loaded on an arbor, and the arbors are located in suitable pockets in a disk feeder-plate, as shown at *A*. The arbors are picked up by a clip *B* attached to an over-arm that is fastened to shaft *C*. This shaft may be oscillated to swing the work held in the clip down in line with the centers between which it is held during the cutting of the teeth. An air-operated plunger produces this downward movement and the arm is returned to its normal position by spring action. The shaft is also moved to the right pneumatically, when picking the arbors out of the feeder-plate, and this movement causes pawl *D* to index the plate and bring the next arbor into position to be picked up by the clip. The movements of this shaft are governed by the cam action which releases the various air valves.

There are two cutter-heads *E*, one for roughing and one for finishing, each of which is lowered into the operative position by a connecting arm. These connecting arms are operated by air cylinders, one at each side of the machine. The tailstock *F* has a female center to engage the work-arbor, and is given a sliding motion, to permit the arbors to be loaded, by the direct application of compressed air. The two tubes by means of which the air is delivered from the cylinder to the tailstock are shown at *G*.

The work *W* is indexed by ratchet *H* and a retainer and take-up pawl. The take-up pawl *I* is especially designed with a heel that forms a wedge between the engaging toe of the pawl and pin *J*. The reciprocating motion of this pawl is air-actuated, and constitutes a locking device which locates the work positively as it is indexed. The air cylinder for operating the indexing mechanism is shown at the left-hand end of the machine.

After each index movement has been completed, and during the time that the saws are in the operative position, the slide *K* is fed forward by cam *L* and a fulcrum lever which raises and lowers stud *M*. The end of this stud bears against a lever which operates the air valve by means of which the feed motion is actuated. A single air tube which delivers air directly to the slide is clearly shown in the illustration. At the opposite end of the slide, in the space shown at *N* are placed two springs which return the carriage after the feeding movement has been completed. An air cylinder and plunger *O*, supported by an outboard bracket at the left end of the machine, constitutes the knock-out mechanism for displacing the arbors from the spindle at the completion of the operation.

Plate Numbering Machine

Train bridges and pillar plates carry identification numbers, and these numbers are stamped by an automatic machine, such as illustrated in Fig. 17. By the use of this automatic machine, it is possible to number forty-three pieces per minute, with six figures each. Slide *A* carries the holder *B* in which the plates are located, and this slide is fed back and forth under the numbering tools by cam *C* on the end of the camshaft and a lever *D*, the fulcrum point of which may be changed by relocating the knurled pin *E* in one of three holes, in order to vary the rate of feed as

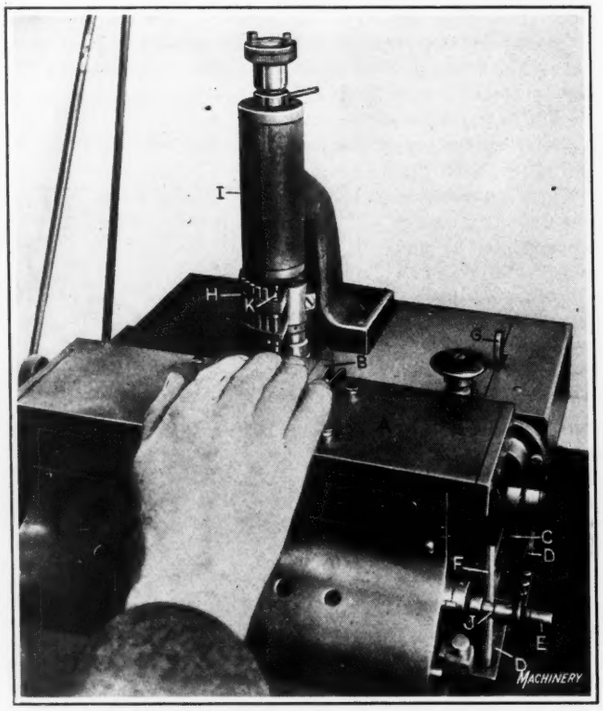


Fig. 17. Numbering Machine for Pillar Plates and Train Bridges

required for different spacings of the numbers. The fulcrum lever operates the vertical stud *F*, the upper end of which bears against a lug on the under side of the slide to produce the forward movement, and springs at the opposite end of the slide provide for its return. The camshaft of the machine extends through the frame at the rear, and is driven from the driving shaft at the front by gears, the gear on the camshaft being operated by a friction clutch to engage or disengage the two shafts. Lever *G* operates this friction clutch, permitting the feed of the slide to stop, as well as the movement of the turret. Under ordinary operating conditions, however, the machine runs continuously with the friction clutch engaged.

The turret *H* is reciprocated by cams or numbering dials carried on shaft *J*. A series of pawls and ratchets, operating in conjunction with springs, positions the number dials so that various stops carried on collars located between the ratchets control the timing and positioning of the angular movement of the turret. There are ten numbering tools or holders, the downward movement of which is actuated by the hammer *K* and the return by individual springs. The hammer is operated in both directions by air, the air cylinder being shown at *I*. The rapid trip-hammer action which is produced by this mechanical arrangement results in accurately spacing the numbers, which progress consecutively by the cam arrangement that brings different numbering tools under the hammer.

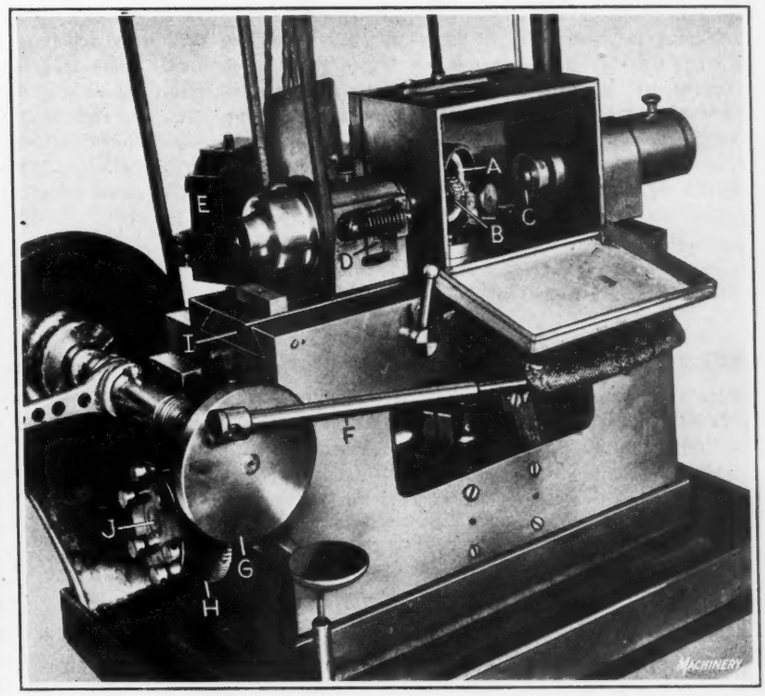


Fig. 19. Air-operated Radial Grinding Machine on which the Screw-heads are ground Convex

Wheel Reboring and Recessing Machine

Small brass wheels, used in the gear trains of watches, have their central hole produced on the machine illustrated in Fig. 18. The operation performed on this machine is that of enlarging the previously drilled hole and of cutting a recess around the hole, forming a shoulder with the rest of the hub. The wheels are loaded into a vertical magazine *A*, and are fed upward by the application of air and gripped by a pair of jaws on arm *B*. The jaws are operated by a toggle-jointed lever *C* when a pin *D* is brought against the vertical post *E*. The position of this post may be adjusted by releasing a pin-lever, which clamps the plate on which the shaft is carried.

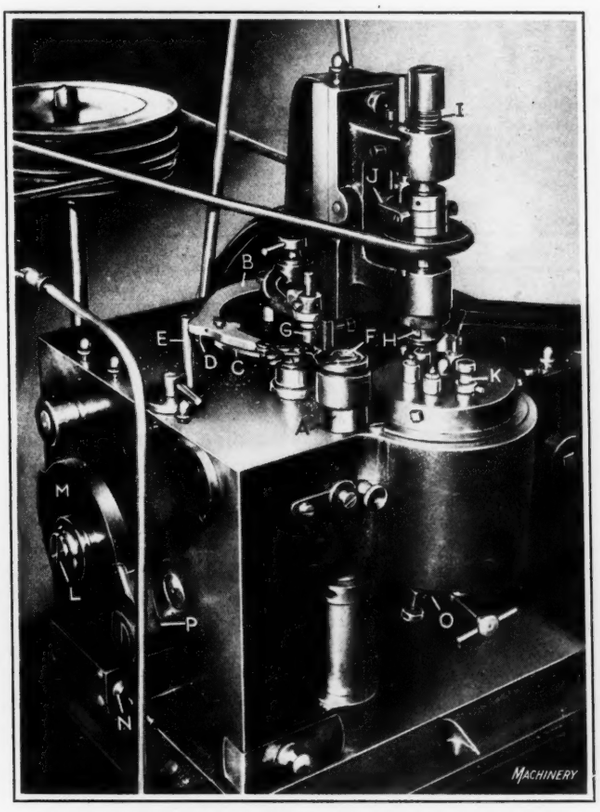


Fig. 18. Machine for reboring the Central Hole in a Watch Wheel and cutting a Recess around the Hole

The air in the vertical magazine forces up the wheels (one of which is shown at *F*) until they contact with stop-pin *G*, at which time they are gripped and deposited in the chuck of the machine. The arm which carries the stop-pin is lowered by cam action and raised by means of a spring, the mechanism being enclosed within the machine frame. The turret of the machine is indexed from station to station, but the tools do not revolve during the cut. To permit the wheels to be deposited in the chuck, it is necessary to stop the spindle so that an opening *H* will always be in the same position, so as to permit the work to be passed through it. The spindle is stopped at a definite place by a cam which controls the vertical feed movement of the spindle head, so that the spindle will be raised by the coil spring *I* to a higher point than it would be ordinarily between each index movement. The additional upward travel brings a dog, on the top of the pulley, into engagement with a finger at the rear of the spindle yoke *J*. This not only stops the spindle in the correct position, but also locks it during the loading operation, the belt slipping while the spindle is thus locked.

The nose of the spindle chuck has a back taper so that as the wheels are released from the jaws, after arm *B* swings the work through opening *H*, they drop down and are supported from the outside diameter, seated against the tapered surface of the hole, in which position they are held down by a spring plunger. Post *K*, mounted at the first station of the turret, acts in conjunction with the spindle plunger to seat the wheels evenly in this back-tapered spindle hole. At the completion of the various operations post *K* is raised by means of the cam, thus dislodging the wheel from its position and permitting it to be swept to the right into a chute.

In addition to the upward feed of the spindles, which is produced by lever *O*, controlled by cams, there is a slight lateral feed movement imparted to the spindle that carries

the facing tool by means of which the recess is cut. This movement is taken care of by a specially designed cam, which is timed by the turret index device. This mechanism is operated by a sector gear actuated by air, the turret being locked by the familiar ratchet and pawl arrangement. The machine is equipped with the usual worm and worm-wheel drive to the camshaft *L*, which carries the various cams to trip the air valves, as well as the feed-cam for governing the vertical travel of the spindle. The feed-cam *M*, working in conjunction with air plunger *N*, operates lever *P* on which the feed-lever *O* is carried. The production rate of this machine is from 210 to 250 wheels per hour.

Finishing Watch Screw-heads

The steel screws used in a Waltham watch have convex heads, which are finished by a rather ingenious method to produce the mirror finish required. Referring to Fig. 20, it will be seen that these screws are assembled into steel balls. These balls, which are hardened and ground, contain holes in which the screws are carried during the finishing of the heads, and the method of loading these balls is of considerable interest.

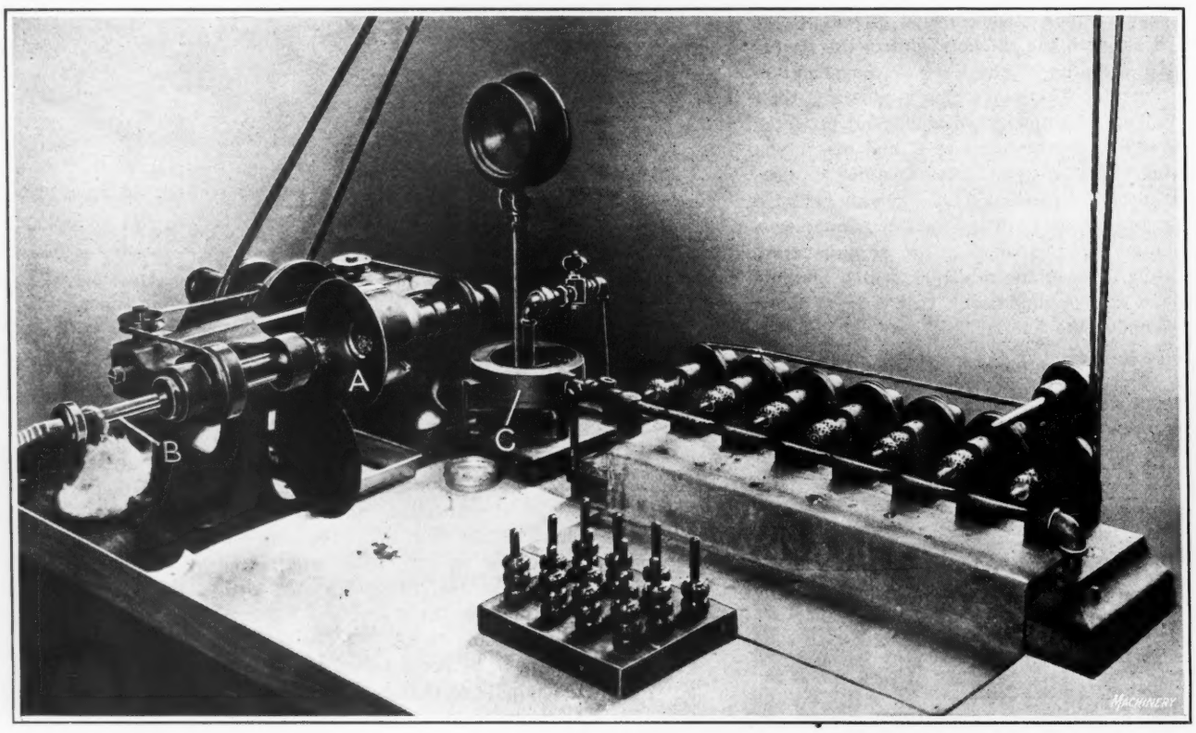


Fig. 20. Equipment used for loading Steel Balls with Watch Screws preparatory to grinding and polishing the Heads

A quantity of screws is placed in a hopper *A*, when the spindle frame is in a vertical position, and then the spindle frame and hopper are swung to a horizontal position, as shown in the illustration. The steel balls have a central tapered hole and are placed on the end of an arbor in sliding spindle *B* and advanced into the hopper and brought into contact with the screws. An agitator is provided for the hopper, and the spindle is hollow, so that by applying a suction air line to the spindle and providing suitable holes in the nose of the tapered arbor on which the ball is assembled, the screws will be sucked into the holes as the ball is revolved. A thirteen-pound pressure produced by suction is employed, and by simply sliding the ball into the revolving hopper and withdrawing it, every hole in the ball will carry a screw, although occasionally the operator is required to reset a screw which is not properly entered in a hole. After the ball has been withdrawn to the position shown in the illustration, it is treated to a solution of silicate of soda and placed on the spindles as shown to the right, directly over a hot-air line connected to an electric stove *C*. The spindles on which the balls are thus suspended are driven by a belt and pulleys. As the balls revolve, the silicate of soda is dried on, and the screws are thus prevented from being dislodged when the heads are subsequently machined.

The heads of the screws are machined by stoning on a pneumatically operated radial type grinder, using a cup-wheel *A*, Fig. 19. A loaded ball *B* is shown located on the work-spindle. The loaded balls are pressed on the work-head spindle by the air-operated head *C*, which positions the ball accurately relative to the center of rotation of the wheel-head *E*. The spindle bearing has provision for locking the spindle after the position has been established, and for releasing it when a ball carrying unground screws is to be located. The locking of the spindle is accomplished by the application of air to the slotted section *D*, and the release by a coil spring attached to the front of the bearing.

The wheel-head *E* is oscillated through its angular travel by the connecting-rod *F*, which has a telescopic connection with the head and which is given a crank motion by connection to the disk *G*. The disk is driven through a clutch on the worm-shaft so that it may be disengaged from the constantly running worm-shaft. Worm-wheel *H* is attached to the outer end of the camshaft *J* and is driven by the previously mentioned worm. On this shaft at the opposite end of the machine there is a cam which operates a lever arrangement for feeding the work-slide *I* forward as the grinding wheel is oscillated over the heads of the screws. The release for the friction clutch which connects disk *G* with the worm-shaft is controlled by a cam on the outside of the worm-wheel.

After the heads have been stoned, they are finally polished by mounting the balls received from the stoning operation on the spindle of a similarly designed machine, which has two opposed spindles that are operated by hand-levers. The polishing is done with boxwood laps, cylindrical in shape and cupped out on the end to conform to the curvature of the steel balls. These wooden laps are charged with "Acme" polish, made by the George Zucker Co., Newark, N. J. This abrasive is of finer grain than either flour emery or crocus. The production time for both the stoning and polishing operations on average size work is 250 balls per day. These balls have a holding capacity of from 30 to 150 screws each.

ADAPTING MACHINE TOOLS TO MOTOR AND SILENT CHAIN DRIVE

By EDWARD H. TINGLEY

While there may be a difference of opinion as to whether it is preferable to drive machine tools by a belt from a countershaft, or by a direct motor drive, or a motor drive through a silent chain, the conditions are frequently such that a silent chain drive is the only type of drive that can be used satisfactorily. The advantages of a silent chain drive need not be enumerated here, but in working out new designs, machine tool builders should take into account the fact that many of their customers will use chain drives with their machines. The application of motors and chain drives to a variety of machine tools in a certain shop brought up the following problems.

Method of marking Ends of Machine Tool Drive Shafts

Changing Machine Tools from Belt to Motor Drive

The first problem encountered in changing a machine from belt to motor drive is that of determining the proper speed of the drive shaft. The latest catalogues of the machine builders usually give the speeds for new machines, but when a machine which has been driven by belt for several years, for instance, is moved to another part of the shop where conditions make it impossible to use a countershaft, and a motor and chain drive have to be installed, it becomes something of a problem to determine the proper shaft speed. Old catalogues are not always available and new catalogues in most cases do not give specifications for old type machines. The speed at which the drive shaft has been driven is not an indication of the speed that should be employed with a chain drive.

A chain drive once installed is not easily changed, while in the case of a belt drive it is a simple matter to change the pulleys in order to obtain a change in speed. Nowhere on any of the machines which were converted from belt to motor drive, in the shop referred to, was there any information relative to the speed at which the designer intended the drive shaft to run. Therefore, it was necessary first to determine the spindle speeds, then calculate the drive shaft speed, taking into consideration all gearing or intermediate belt drives, and install the chain drive accordingly. Why is it not possible to have the manufacturers of machine tools mark the correct speed in the end of the drive shaft? The speed should not be painted on the belt guard nor printed on a tag tied to the countershaft, as more than likely neither will be in evidence a year or more after the machine is purchased. It is also necessary to know the direction of rotation of the drive shaft when setting up a machine. The accompanying illustration shows how the end of a drive shaft could be marked to give the necessary information regarding speed and direction of rotation.

Correct Motor Speed

Some manufacturers have already adopted the plan of marking the ends of the drive shafts of their machines. The marking of a shaft in this way is most important in machines that depend on the splash system of lubrication for the gearing. The daily loss in production resulting from too slow a speed may be hardly noticeable, and yet the yearly loss may reach a considerable amount. Many machines of the latest design have a constant-speed drive shaft with change-gears to obtain a variety of speeds. This type of machine can be easily equipped for operation by a constant-speed induction motor. However, designers should so determine the drive shaft speed of a machine that it will have the proper ratio to the 1150 or 1750 revolutions per minute of standard motors. About the smallest motor pinion used with silent chain drives contains nineteen teeth of possibly ½- or ⅝-inch circular pitch.

Using the two customary motor speeds—1150 and 1750 revolutions per minute—the drive shaft speed must be such as to allow a sufficient number of teeth in the silent chain gear to provide for the necessary mechanical construction of the hub, flange, etc. A speed of 400 to 450 revolutions per minute of the driving shaft will give a satisfactory ratio with motors having a speed of 1150 revolutions per minute. Most manufacturers of chain drives advise against using a high peripheral speed of the chain, as this has a tendency to lift the chain off the teeth. Experience seems to indicate that (considering repairs to motors, interchangeability, and general adaptability of motors to machine tools) 1150 revolutions per minute is the best speed for all shop motors, either belt or chain drive, and 1750 revolutions per minute is satisfactory for direct gear-driven automatic machines.

Location of Motors

Another problem encountered in installing motor chain drives is that of finding a suitable place on the body of the machine on which a bracket for the motor can be mounted. If the drive shaft is located near the floor, the motor can be bolted to the floor, provided the center distance between the motor shaft and drive shaft is not more than 30 inches. If the drive shaft must be located a considerable distance above the floor, provision should be made in the design of the machine to permit the mounting of a suitable sized motor bracket. A flat surface or machined pads cast integral with the frame of the machine will make the work of mounting a motor much easier.

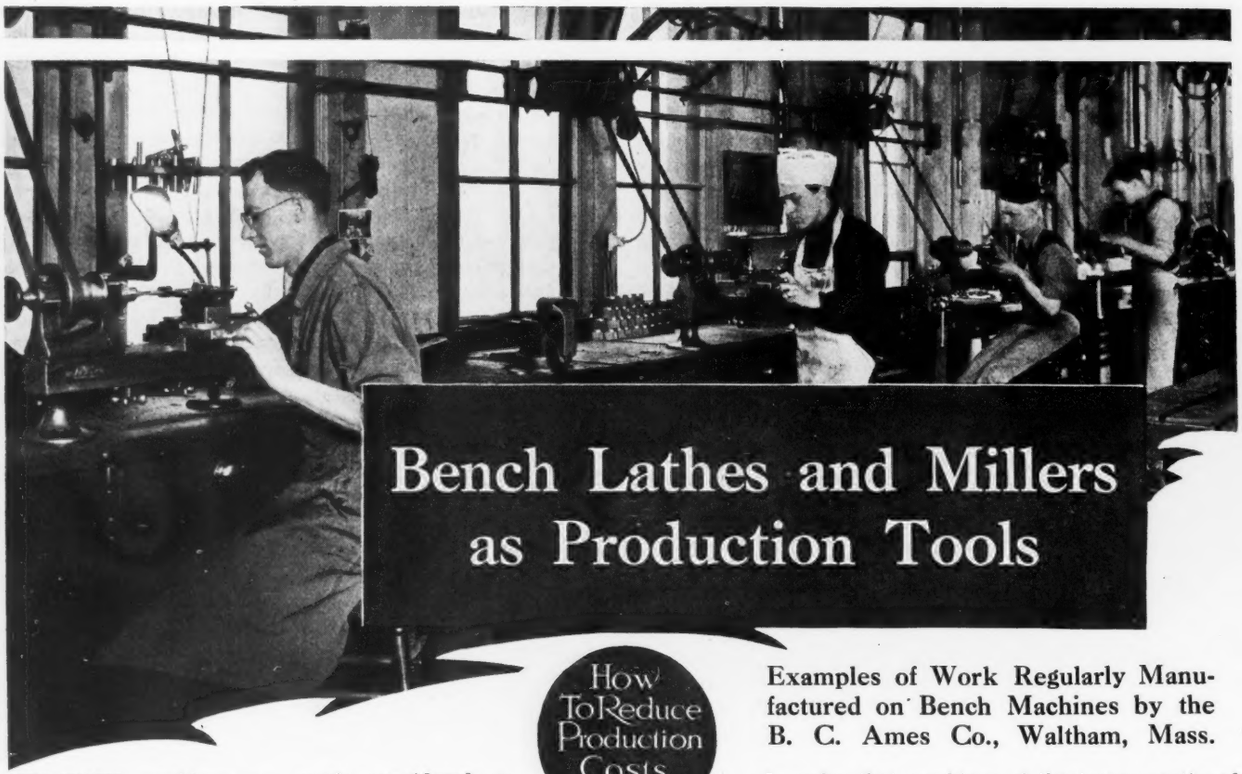
Selection of Motor

Within the last year, one of the largest motor manufacturers has put a motor on the market, which, when run at full load will attain a temperature rise of 50 degrees C., but no overload capacity is guaranteed. Compared with the old rating of a full load at a rise in temperature of 40 degrees C., it would seem that the new motors are over-rated about 15 per cent. When the machine tool catalogue calls for a 5-horsepower motor, will a motor having a rise in temperature of 40 degrees C., with a 25 per cent overload capacity be required, or will the motor with no overload capacity, but a permitted rise in temperature of 50 degrees C., prove satisfactory? When the catalogue reads "3 to 5 horsepower" the motor selected should be either a 5 horsepower, no overload, or a 3-horsepower motor having a rise in temperature of 40 degrees C.

In the majority of cases, too large a motor is used on machine tools, thus giving poor load conditions on the motor and resulting in low efficiency and unnecessary expense for unused power. Even in the steadiest of production work, there are always intervals in the cycle of operations when the motor is pulling only the friction load of the machine. This makes the average load on the motor considerably lower than would be expected, and should be borne in mind by those who write the specifications for machine tool catalogues. The requirements should be made to agree with the standard sizes, that is, the catalogues of machine tools should specify standard size motors or motors of sizes most easily obtained such as 1, 1½, 2, 3, 5, 7½, 10 and 15 horsepower, etc.

* * *

In a recent Commerce Report, it is mentioned that an American manufacturer who has been investigating the market for bolts and nuts in Norway states that German firms now almost completely control the Norwegian market in this field. It is stated that German firms are now quoting lower prices and filling orders in less time than domestic Norwegian factories.



Bench Lathes and Millers as Production Tools

How To Reduce Production Costs ?

Examples of Work Regularly Manufactured on Bench Machines by the B. C. Ames Co., Waltham, Mass.

BENCH machines are rarely considered as production equipment. In most cases they are regarded as precision tools, but are not regularly made use of where quantities of parts are to be made even though a high quality of the product is desired. There appears to be no reason, however, why certain classes of work should not be manufactured on a production basis with machine tools of the bench type. Although these machines are regarded as precision equipment, and are suitable for high-grade production work, when large quantities of high-grade work are to be made the hand screw machine or the floor type milling machine is generally selected for the work; but the bench machine is often just as suitable for general manufacturing purposes. There are also the factors of lower first cost, conservation of floor space, and general applicability of bench machines, which should receive consideration.

In order that machines of the types mentioned may be better appreciated as production tools, a number of operations regularly performed on bench lathes and milling machines by the B. C. Ames Co. in their factory at Waltham, Mass., have been here selected. These jobs are performed with Ames equipment, most of which is standard, and all of which can be readily applied to the machines. The Ames lathes and bench millers are made with standard size ways, so that the headstocks, tailstocks, index-heads, and other fitted members may be used interchangeably on these two machines. The spindle heights are also the same, and the collets used are identical.

Grinding Bearings in Collet Chucks

The spring collets used in the Ames machines are ground internally to form a bearing surface for the work to be chucked. This is one of the regular production jobs handled

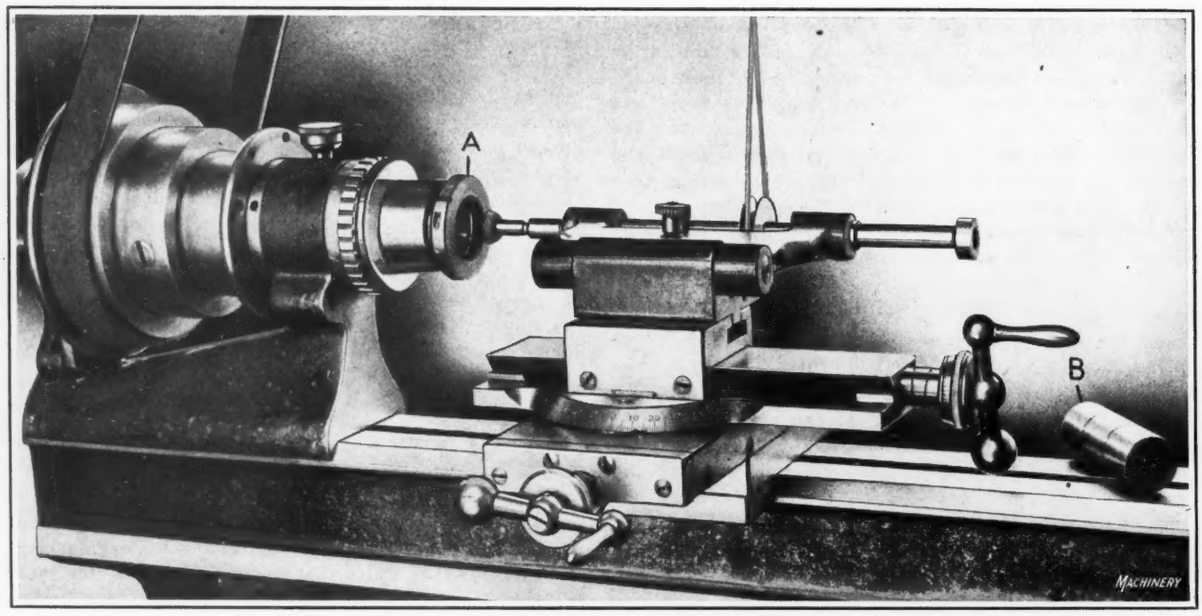


Fig. 1. Bench Lathe Set-up for grinding Internal Bearing Surfaces in Spring Collets

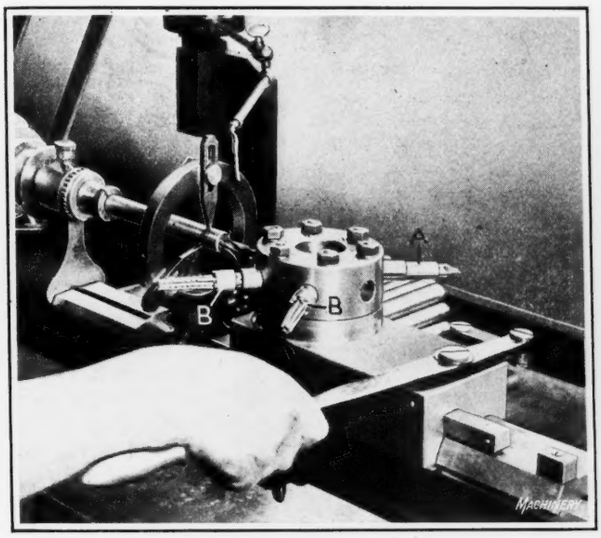


Fig. 2. Machining the Taper Hole in Tail-spindles on a Bench Lathe

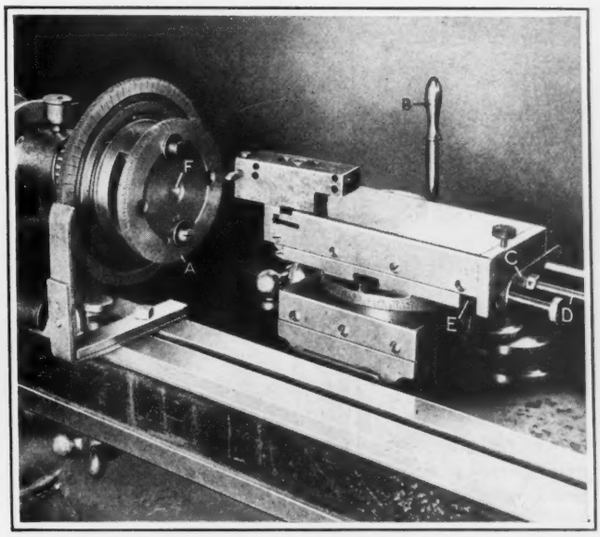


Fig. 3. Equipment used for graduating on a Bench Lathe

on a bench lathe, and the set-up used in the operation on a 1-inch collet is illustrated in Fig. 1. The traversing grinder spindle runs without oil in steel bushed bearings mounted on the compound slide rest of the lathe and driven by a round belt as shown. The grinding wheel used in this operation is a Norton alundum 36-60 K wheel and operates at a speed of 10,000 revolutions per minute. To prevent the collets from springing while being chucked, a grinding liner *A* is used. This is simply a collar which fits over the end of the collet and which has three spacing pieces to fill the slots in the collet and prevent contraction. The operator feeds the spindle to the proper radial depth with the cross-feed screw and then pushes the spindle in and out until the bearing surface is ground to the proper diameter and to a length of about one inch.

The machine spindle is driven at 1800 revolutions per minute, and this, in combination with the grinding wheel speed, brings the surface cutting speed up to approximately the recommended grinding speed of 5000 surface feet per minute. A "Go" and "Not Go" plug gage, shown at *B*, is used for inspecting the hole. Production for the 1-inch size of chuck is sixty pieces per day. Beyond the ground bearing surface machined in this operation, another grinding operation is performed subsequently which provides a clearance of from 0.006 to 0.008 inch extending through the chuck. Chucks of small size (less than ¼ inch) are ground on their internal bearing surfaces by using diamond laps. The smallest of these diamond laps is 0.005 inch in diameter, and the operation is performed by simply replacing the grinding wheel with a lap, which has a standard taper shank to fit the grinder spindle.

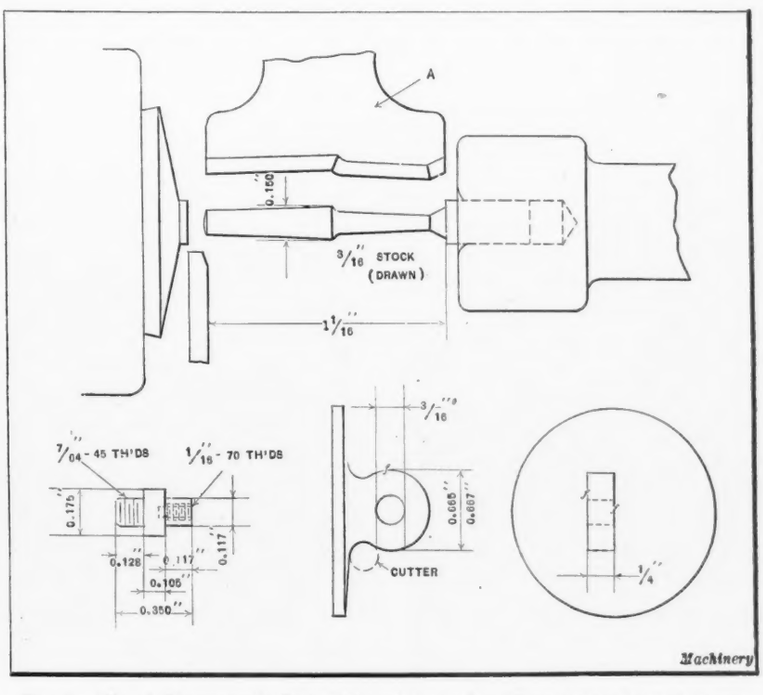


Fig. 4. (Above) Diagrammatic Tooling Lay-out for making Taper Points for Dial Gages; (Below) Two Examples of Work machined with Bench Equipment

Machining Morse Taper Hole in Lathe Tail-spindle

The operation shown in Fig. 2 is that of drilling and reaming a taper hole 2 3/16 inches deep in the end of a tail-spindle for a No. 3 Ames lathe. This work is perhaps a little heavier than is usually conceived of as suitable for a bench lathe, but this is a regular production job which is handled in good time with the set-up shown. The work is held in a steel step-chuck, the step being 3/16 inch deep. The opposite end of the work is supported by a three-jaw brass steadyrest having a foot to fit the lathe bed.

The first operation is spot-drilling with the centering tool *A*, after which the hole is drilled to the required depth, as determined by the regular turret-slide stop. Rough- and finish-reaming operations are next performed in order, with two taper reamers furnished with special stop-collars *B*. By this provision the depth of the tapered hole will always be correct, regardless of variations in the length of the work or in the method of chucking. By bringing the stop-collars up hard against the end of the work, this surface becomes the locating surface regardless of any other consideration. The hole has a standard No. 1 Morse taper, and the time required on this job is five minutes per piece, which includes chucking time. In chucking the work, it is necessary for the operator to use both hands, and to aid him in getting a firm grip on the work, the step pulley is locked by a pin to prevent rotation. These tail-spindles are made of cold-rolled steel, and are casehardened.

Graduating Base of Vise

Another bench lathe job regularly performed is that of graduating the base of milling machine vises, and for this work certain special

equipment is needed, as shown in Fig. 3. A rack-and-pinion slide-rest, which is standard Ames equipment, is attached to a right-angle shoe which extends from the rear of the machine and which is located properly by the regular T-slot on the back of the lathe bed. An ordinary pointed drill-rod tool is used for graduating, this being attached in the simplest possible manner to a block carried on the slide-rest in the position shown in the illustration. The work to be graduated is shown at *A*, and is located by a pilot *F* over which the work is slipped. Holes in the work are made use of in attaching the castings to the driving plate on which they are located. The index-plate has 360 ratchet teeth and is held in position by a suitable spring finger. The side of the index-wheel also is graduated, so that the operator can tell at once when he must change the length of the graduation lines which he is cutting on the work; that is, every 5 or 10 degrees a longer line is scribed, and when these marks are reached, adjustment of the tool traverse is made accordingly.

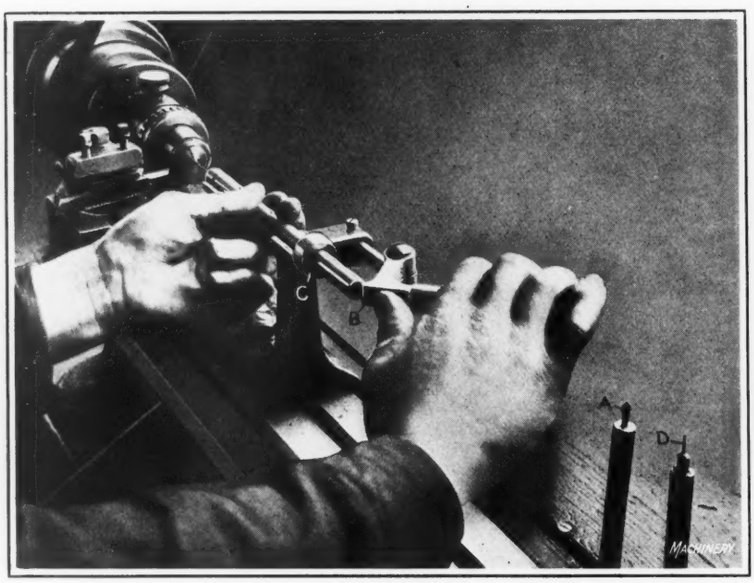


Fig. 5. Drilling the Hole in a Small Stud preparatory to tapping

In cutting the short graduations, the operator simply moves the top slide longitudinally back and forth by means of handle *B*. The other hand is kept constantly on the spring finger with the thumb on the index-plate, so that with each withdrawal of the tool, the spring finger is sprung outward and the thumb used to advance the plate another notch. After a little practice this operation becomes automatic and by observing the graduations on the side of the index-plate, the operator can readily see when the longer lines are to be cut. At this point, he simply throws the latch *C* out of contact with the nut on screw *D*, which permits the top slide to advance on the next forward movement an additional distance equal to the difference in length between the long and short lines.

The tool-block is provided with an adjusting screw for bringing the cutting point of the tool into the same horizontal plane as the center of the work. In cases where the work does not overhang from the driving plate as it does in the present instance, the tool is increased in travel from the beginning of the cut rather than at the end, and when this practice is followed, a spacing block is used for a stop, which is removed from between the end of the stop-screw and surface *E* when cutting the longer graduations. These vise bases are made of cast-iron, and are graduated through 360 degrees in thirty minutes. The lines produced by this method of graduating are even and accurately spaced, and the work can be done much more quickly than by employing an index-head on the milling machine, and in a more satisfactory manner than by rolling the graduations with a knurling tool.

Machining Lever Studs for Dial Gages

Lever studs used on Ames dial gages are first turned and threaded and then faced on one end, center-drilled, and tapped with the equipment shown in Fig. 5. A detail of the lever stud which is made of cold-rolled steel, is shown in the lower left-hand corner of Fig. 4, from which the size of the work and the nature of the operations performed may be readily seen. The collet chuck in which the studs are held, to assure correct facing length, is furnished with an independent stop. The first operation is that of facing to length, locating the work by this stop and using the tool shown in the front tool-holder on the cross-slide. The end of the work is then centered with tool *A*, the spindle in which this tool is carried being laid in the half-open tailstock and fed into the work by the hand-lever *B*.

The next operation is drilling the hole with a No. 50 drill. This is the operation shown in process, and the illustration indicates how the hand-lever is operated to advance the tool-holder until stop-collar *C* is brought into contact with the rear face of the back bearing of the tailstock. The last

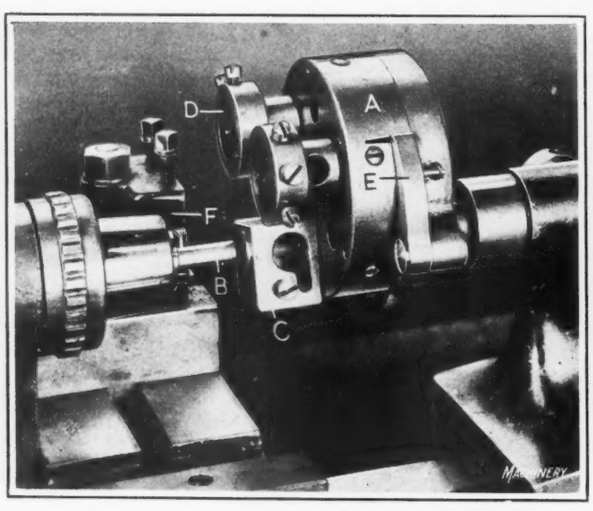


Fig. 6. Bench Lathe with Turret Head, used in making Fillister-head Machine Screws

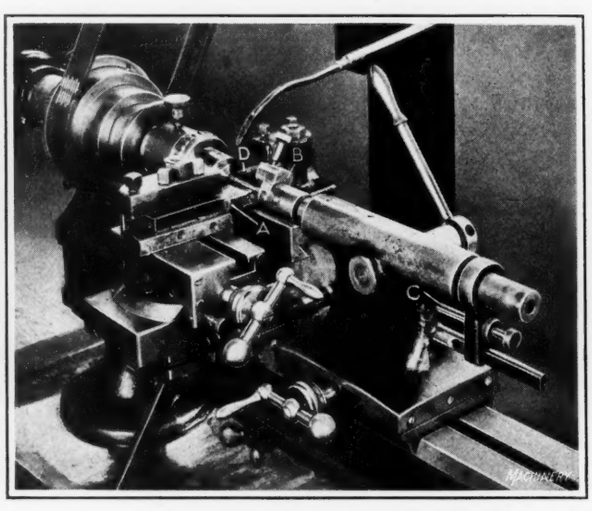


Fig. 7. View of the Bench Lathe Set-up used in making Taper Points for Dial Gages

operation consists of tapping the hole, the tap being shown at *D*. It will be seen from Fig. 4 that this is a 1/16–70 thread tap, and the hole is 0.117 inch deep. Each tool is provided with a stop-collar similar to the drill spindle, so that the depth of hole is accurately maintained from the end of the work after it has been faced, rather than from the collet stop against which it is located for facing to the proper over-all length. In the tapping operation, the operator holds the tap spindle in the half-open tailstock bearing, with one hand, and works the belt back and forth similar to the action of hand-tapping. These lever studs are machined as described at the rate of thirty per hour.

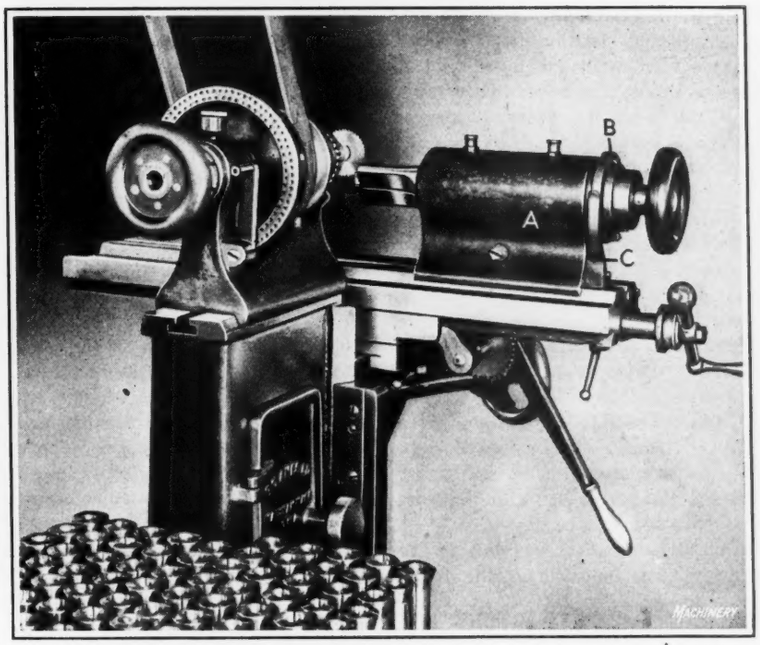


Fig. 8. Bench Milling Machine, and the Set-up used in slotting Spring Collets

Making Fillister-head Screws on a Bench Lathe

The production job, the set-up for which is shown in Fig. 6, is that of making fillister-head machine screws from cold-rolled steel. These screws are ¾ inch long and have a 3/16–32 thread. The tail-spindle which carries the turret-head *A* is located against a stop which bears on the rear end of the tailstock, thus definitely locating the tools relative to the work. The stock, which is shown projecting from the chuck at *B*, is then advanced through the lathe spindle, against a stop located on the face of the turret-head between the box-tool *C* and die-head *D*, in which position it is secured by the lever-chuck closer regularly provided on Ames bench lathes. In turning the stock to the correct diameter, the box-tool is provided with a separate stop on its inside wall in alignment with the stock, which governs the turned length. This stop is adjustable to accommodate various lengths of the same diameter stock. Rough- and finish-threading dies are next brought successively into operation by indexing the turret; this is accomplished by depressing latch *E* which, when the turret-head is in the operative position, is held by spring tension in the registry notches. The threading dies may be adjusted for wear by the screws shown on the outside of the holders. Finally, the work is cut off and the screw-heads chamfered by a tool carried in the rear tool-holder *F*. The production time for this job is three hundred screws per nine-hour day.

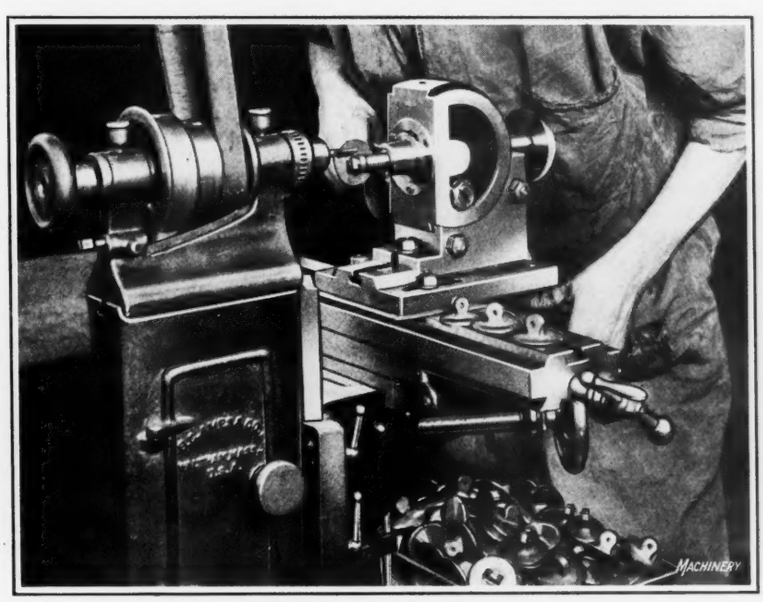


Fig. 9. Milling the Circular Lug on Ames Gage Back on a Bench Miller

Making Taper Points for Dial Gages

Taper points for Ames dial gages are made with the bench lathe equipment illustrated in Fig. 7. A diagrammatic tooling lay-out of this job is also shown in the upper part of Fig. 4, which gives an idea of the size of the part and the relation of the tools used in producing it. The pins are 1 1/16 inches long and they are made from 3/16-inch drawn stock. It will be observed that in Fig. 7 the position of the forming tool and cutting-off tool is reversed from that shown in the diagram, but the method of setting the job up is flexible enough to permit either arrangement. The special forming tool *A* produces a 1-degree taper 9/16 inch long for the body, and a 1½-degree taper ½ inch long for the shank. The stock is fed against a stop *B* attached to the tail-spindle and this stop carries a spring pin having a knurled head. This pin bears against the stock after it has been brought into contact with the stop and acts as a steadyrest for the end of the work, which rests in a V-block directly beneath the stop, and is held in this position by the pressure exerted by the spring pin.

The adjustable stop for the tailstock, shown at *C*, is of similar construction to the one referred to in connection with Fig. 6, and is of vital importance in setting up the job. The tailstock is operated by a rack-and-pinion feed to bring it against this stop, and establish the location of the stop. The tail-spindle is relocated for each piece, which permits the stock to be fed through the spindle further than required for actually making the piece, so that with the end of the stock against stop *B*, the tailstock may be advanced, pushing the stock back, thus facilitating chucking to the correct length. The wide-faced, special forming tool *A* is secured in a rugged tool-holder, and the cut-off tool *D* is carried in a block at the rear of the cross-slide. Although there is nothing unusual about the set-up for this operation, the fact that these pins are produced in quantity, free from chatter marks and to size, with bench equipment at the rate of thirty-six per hour, is noteworthy.

Typical Bench Miller Work

A set-up which shows the value of the bench miller as

a production tool is illustrated in Fig. 8, the job performed with this equipment consisting of slotting collet chucks. The milling machine is provided with an index-head *A* which has an index-plate *B* and a spring index-finger *C* for positioning the spindle of the head for every 120-degree revolution of the work. The draw-in tube screws into the collet to be slotted, similar to the construction of an ordinary draw-in chuck. The collet has a taper bearing in the spindle and is also located by a stop so that it cannot be drawn in so far as to cause the work to spring together and bind on the saw during the slotting operation. Thus, although the work is chucked on the end that is slotted, the tension is so regulated that the collets are held firmly but without binding on the slitting saw. Hand feed is used for traversing the table during the operation, the length of the table traverse being determined by a stop. It will be noticed that the nose of the spindle is slabbed on three sides to give clearance for the arbor, and to allow the saw to reach through the collet. A 1¾-inch saw, 0.027 inch thick, is used for this operation, and the production time is from fifteen to twenty-one collets per hour.

The hand milling operation shown in Fig. 9 is milling the circular lug on gage backs for Ames indicators. The detail of this part is shown in the lower right-hand corner of Fig. 4, the surface to be milled being indicated by the limit dimensions for the lug, the tolerance on the diameter being 0.002 inch. The operation is performed with an end-mill, which when new is 5/16 inch in diameter, and which is used until it has worn down 1/16 inch. These cutters are made of plain drill rod, and are manufactured in quantities, because the nature of the work causes frequent replacements. The work is clamped to the end of a spindle carried in the index-head, and is then swung around until the cutter fits in the curved surface which joins the lug and the flange of the work, as indicated by the dotted lines in Fig. 4. The index-head is attached to a right-angle shoe secured to the milling machine table, and after the table has been adjusted to position the work for starting the cut, the index-handle of the head is turned by hand, thus swinging the work around under the cutter until the cutter has reached the joining curved surface on the opposite side of the work. The end-mills are necessarily made long in order to reach by the flange of the work, and being slender, care must be exercised to prevent excessive breakage of the tools.

In making the work-arbor, an interesting construction is used. This consists of extending a long center stud through a hole in the arbor, this stud being driven by a pin extending through the arbor. The end of the stud is threaded and extends beyond the arbor, and on it the work is located by the central hole, and then secured in position with a nut. If the arbors were made solid with a projecting threaded slender end, the percentage of breakage of this threaded portion would be high and the expense of making the arbors great. The illustration shows the position of the end-mill at the beginning of the cut and the convenience with which the operator works in the performance of this operation. The end-mill is rotated at 1600 revolutions per minute, and the production is fifty gage backs an hour.

* * *

STEELS RECOMMENDED BY THE GEAR MANUFACTURERS' ASSOCIATION

At the fifth annual meeting of the American Gear Manufacturers' Association in Cincinnati, Ohio, the list of forged and rolled steels given in the accompanying table was recommended for use in the manufacture of gears. These steels were selected with the aim of eliminating, as far as possible, steels which overlap one another in physical properties. The steels are to be identified by the specification numbers employed by the Society of Automotive Engineers, although the properties of some of the steels differ slightly from those of the S. A. E. steels having identical numbers.

Steel 1020 is a straight carbon steel suitable for casehardening. Steel 1030 differs from the regular S. A. E. steel of this number in that the maximum phosphorus content is 0.050 instead 0.045 per cent. This steel is intended for use mainly in an untreated state against an iron or steel casting. When it is desired to harden it somewhat, this may be accomplished by heating it and quenching in water. Steel 1045 is to be known as S. A. E. 1045 special. It differs from the regular S. A. E. steel of this number in the manganese content, the percentage of this element specified being 0.30 to 0.50, instead of 0.50 to 0.80 per cent. This modification gives a steel more suitable for water-quenched gears. Steel 2315 is a standard 3.5 per cent casehardening nickel steel, while steel 2345 is a standard 3.5 per cent oil-hardening nickel steel, and the companion steel to 2315.

Steel 3115 is a chrome-nickel steel suitable for casehardening, both the chromium and nickel contents being low. Steel 3215 is a chrome-nickel steel, also suitable for casehardening, in which the chromium and nickel contents are medium, while steel 3245 is another medium chrome-nickel steel suitable for oil-hardening. Steel 3315 is a casehardening chrome-nickel steel in which the chromium and nickel contents are high. Very high physical qualities can be secured in this steel when it is correctly treated. Steel 3340 is an oil-hardening chrome-nickel steel in which the chromium and nickel contents are high. It is the companion steel to 3315, and like it, high physical properties may be secured by heat-treatment. Steel 6120 is a chrome-vanadium steel suitable for casehardening, while steel 6145 is an oil-hardening chrome-vanadium steel, and the companion to 6120.

COMPOSITION OF STEELS RECOMMENDED FOR USE IN THE MANUFACTURE OF GEARS BY THE AMERICAN GEAR MANUFACTURERS' ASSOCIATION

S. A. E. Specification	Carbon, Per Cent	Silicon, Max., Per Cent	Manganese, Per Cent	Sulphur, Max., Per Cent	Phosphorus, Max., Per Cent	Nickel, Per Cent	Chromium, Per Cent	Vanadium, Per Cent	Manufacturing Process
1020	0.15–0.25	0.10–0.25	0.30–0.60	0.050	0.045	.....	.....	.....	Open-hearth
1030*	0.25–0.35	0.10–0.25	0.50–0.80	0.050	0.050	.....	.....	.....	Open-hearth
1045*	0.40–0.50	0.10–0.25	0.30–0.50	0.050	0.050	.....	.....	.....	Open-hearth
2315	0.10–0.20	0.10–0.25	0.50–0.80	0.045	0.040	3.25–3.75	.....	.....	Open-hearth
2345*	0.40–0.50	0.10–0.25	0.50–0.80	0.045	0.040	3.25–3.75	.....	.....	Open-hearth
2350*	0.45–0.55	0.10–0.25	0.40–0.70	0.045	0.040	3.25–3.75	.....	.....	Open-hearth
3115	0.10–0.20	0.10–0.25	0.50–0.80	0.045	0.040	1.00–1.50	0.45–0.75	.....	Open-hearth
3215	0.10–0.20	0.10–0.25	0.30–0.60	0.040	0.040	1.50–2.00	0.90–1.25	.....	Open-hearth
3245	0.40–0.50	0.10–0.25	0.30–0.60	0.040	0.040	1.50–2.00	0.90–1.25	.....	Open-hearth
3315	0.10–0.20	0.10–0.25	0.30–0.60	0.040	0.040	3.25–3.75	1.25–1.75	.....	Electric
3340	0.35–0.45	0.10–0.25	0.30–0.60	0.040	0.040	3.25–3.75	1.25–1.75	.....	Electric
6120	0.15–0.25	0.10–0.25	0.50–0.80	0.040	0.040	.....	0.80–1.10	0.12–0.25	Open-hearth
6145	0.40–0.50	0.10–0.25	0.50–0.80	0.040	0.040	.....	0.80–1.10	0.12–0.25	Open-hearth
6150	0.45–0.55	0.10–0.25	0.50–0.80	0.040	0.040	.....	0.80–1.10	0.12–0.25	Open-hearth

Machinery

*Also to be known as A. G. M. A. specifications.

How To Reduce Production Costs ?

Efficient System of Hiring Men

Methods Adopted by a Large Manufacturing Plant for Insuring the Selection of the Applicants Best Suited for the Work

By RUSSELL J. WALDO

ONE of the principal factors affecting the cost of production is the human equation, and if industrial engineers expect to lower costs, only capable men who are reasonably certain to remain with a concern should be hired. Such employes are to be had if the man responsible for hiring them has any method whereby he can recognize them among other applicants. Satisfactory results along this line have been obtained by the Studebaker Corporation through the use of the methods outlined in the following, and it is believed that by careful application of the same methods, equally good results may be secured by other organizations.

When this system was instituted, a vast amount of work was imposed upon the employment department, owing to the fact that a new plant was being opened, which required a large number of new employes to be hired, in addition to those taken on to meet the ordinary demand. Therefore, it was necessary to have an employment department personnel which would seem a burden to many. This organization is represented diagrammatically in Fig. 1, the employment manager being in general charge of all phases of the work. The assistant manager interviewed all applicants and hired desirable ones. There were four write-up clerks, whose duties consisted of making complete records of all men hired. All of these clerks were usually busy on Mondays and Tuesdays on this work, but during the remaining days of the week when a less number was required for this purpose, some of them were assigned to other duties in connection with the employment department, such as research, completing records, and making out reports. This scheme made it possible to handle all the work of the employment department with a smaller number of employes than would otherwise have been necessary, and gave the write-up clerks a variety of work. The physician was in charge of the physical examination of applicants. The general duties of all other members of the staff of the employment department should be obvious from their titles which are given in the illustration Fig. 1.

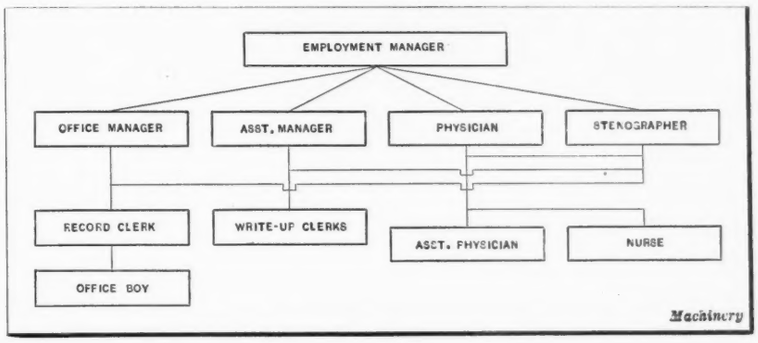


Fig. 1. Chart representing Organization of Employment Department

Plan of Operation

The floor plan of the employment department is illustrated in Fig. 2. An applicant enters door *A*, receives a numbered slip from a clerk seated at *B*, and then takes a seat in either of the waiting rooms *C*. A fence three feet high encloses both of these rooms on the entrance corridor sides. A seat large enough to accommodate four applicants is placed at *D* and this is kept constantly filled by those who are to be interviewed. The men in charge of the waiting rooms seat applicants upon this bench in the order in which they apply. The interviewer, or assistant employment manager, is located in room *E* where he carefully examines each applicant by a system to be described later, and then sends him through the rear door into corridor *F*.

Here a successful applicant waits his turn to have a complete record made by the write-up clerks in rooms *G*. The latter are large enough for a desk and two chairs, and still have sufficient space for moving about. When the record has been completed, the applicant passes into corridor *H* and

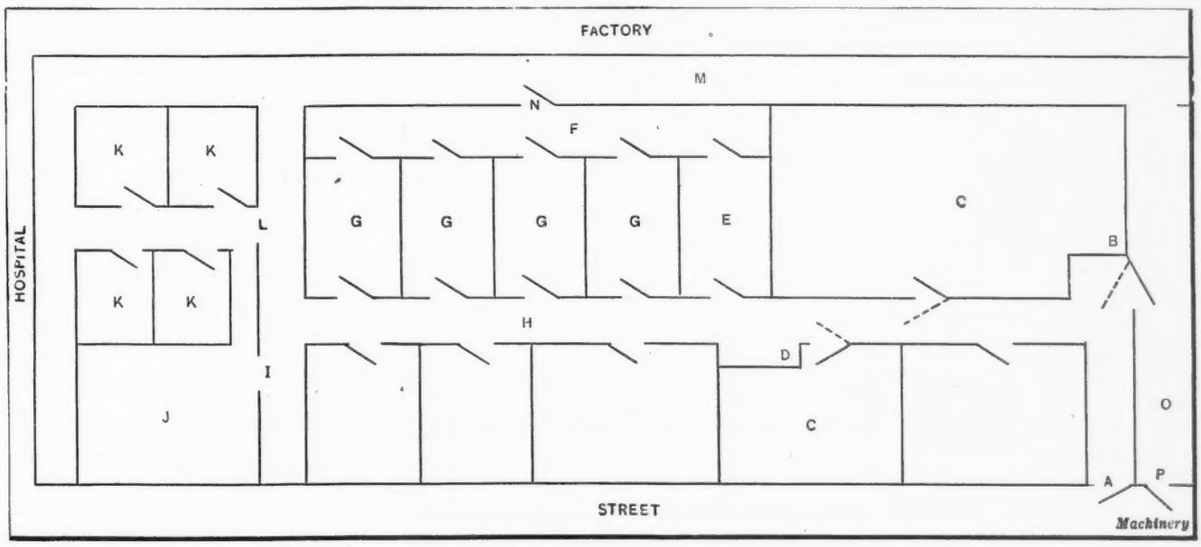


Fig. 2. Arrangement of Waiting Rooms, Offices, and Corridors in the Employment Department

through door *I* into the waiting room *J* of the physical examination department. These examinations are conducted in dressing rooms *K*. After being examined, the applicant passes through door *L* and into corridor *M*, from which he goes to the pay department to receive a clock number. While in the waiting room of the latter department, the new employe is instructed in the use of the time-clock, and his card is stamped.

If an applicant is undesirable, he passes from corridor *F* through door *N*, up corridors *M* and *O* and out door *P* to the street. When an applicant is to report for work at a later day, he leaves the office in the same manner, and his record is made by a write-up clerk when he reports for duty. This scheme prevents a man from passing by the general waiting rooms of the employment department.

D 1165 | Requisition No. | Studebaker

REQUISITION FOR HELP

Plant No. _____
Department No. _____
Date _____

INSTRUCTIONS:—Made in duplicate by Foreman requiring help; both copies forwarded to Labor Superintendent to approve, fill in requisition number and forward original to employment office as authority to hire; duplicate retained by Labor Superintendent.

Rate

Kind of help wanted _____

When wanted _____ (Date) on shift 1 2 3 at _____ A.M. P.M. _____ Replacement Additional

Equipment _____ Book rate _____ Piece work Day work _____

Remarks _____

_____ Dep't Head _____ Labor Supt.

Fig. 3. Requisition filled out by the Foreman of the Department requiring Additional Workmen

Forms Used by the Employment Department

When a person applies for a position by mail, a form is sent to him to be filled out, containing questions as to the age, height, and weight of the applicant, whether the applicant is married or single, whether he speaks the English language, what sort of position he desires, where he has been previously employed, and in what capacities. The application form, when returned, is filed according to the position asked for, until a place is available. The requisition used by a shop when additional help is needed, is shown in Fig. 3. This is made out in duplicate, the duplicate being retained by the labor superintendent, while the original is sent to the office manager of the employment department. If the latter is satisfied that an additional man or men are required by the requisitioning department, the form is forwarded to the office of the assistant employment manager where it is filed according to the requisitioning department until a man is assigned to the job. When this occurs, the requisition is sent to the write-up clerks with the man employed. Thus, it not only becomes a part of the record of the employe, but also, when the form is initialed by the interviewer in the upper right-hand corner, gives the write-up clerks the authority to make a record of the man being hired.

A daily record of all requisitions on file is kept on a sheet, so that it is possible to tell every position open by simply glancing at the record. As each man is hired a suitable indication is made on this record so that not more than one man will be employed for the same job. In this way the record serves to keep track of the number of men sent to each department a day. When new requisitions are received, suitable notations are made on the record before the requisition slips are filed.

The information on the daily record sheet is later transferred to a permanent record, which gives the total number of men sent to each department, according to the classes of work for which they were employed. This record includes only those who start to work immediately. A man instructed to return for work at a later date is not recorded until he actually begins working. Such a man is given a slip showing that he has been hired, the department number in which he is to work, and the rate of pay he is to receive. When he returns at the proper time, this slip takes the place of that which an applicant ordinarily receives upon entrance. Persons with employed slips have precedence in going through the routine of the employment department.

A record of each employe is made by the record clerk on the front and back of a large card on which all information obtained by the write-up clerks and from the examining physician is included. There is also plenty of space for recording changes of address and clock number, transfers about departments, wages received per day, etc. The employe is required to sign this card. A notice of factory employment, made in duplicate, accompanies this record. This notice is shown in Fig. 4. The original is used by the cooperative representative in presenting the new employe for physical examination, to the pay department, and to the foreman of the department for which the man was hired. The foreman notes the starting time thereon, and returns the card to the cooperative representative, who delivers it to the pay department where the name of the employe is entered on the payroll, after which it is forwarded to the time department. The duplicate is filed in the employment department as a permanent record.

A small yellow slip is used by the employment department when a man is to be transferred from one department to another. Fig. 5 shows the front of a card filled out by the foreman when a new man is sent to him. The reverse side, shown in Fig. 6, is filled out by the foreman when the man is transferred from the department, is laid off, or leaves of his own volition. When an employe is transferred to another foreman by the cooperative department, notice of the transfer is made on the form illustrated

W415 | Studebaker

NOTICE OF FACTORY EMPLOYMENT

Plant No.
Dept. No.
Clock No.

INSTRUCTIONS:—Made in duplicate by Employment Department for each person employed. Original used by Co-operative representative in presenting new employee to physician for physical examination, to Paymaster for clock number and Three-Day Pass, and to Foreman for employment. Foreman notes starting time thereon, signs and hands to Co-operative representative who delivers to Paymaster's Department which enters name on roll and forwards to Time Dept., except in cases where applicant does not accept employment, in which event allotment of clock number is cancelled and original sent to employment Department. Duplicate retained by Employment in alphabetical file.

Mr. _____ Foreman _____ 19____

As per your requisition for a _____

Mr. _____ Age _____

has been employed to report _____ 19____ Rate _____

Remarks _____

Signed _____
Employment Dept.

TRANSFERS						FINALED
DATE	FROM DEPT.	TO DEPT.	DATE	FROM DEPT.	TO DEPT.	Date _____ 19____
						Reason:

Fig. 4. Notice of Employment, which follows the Route given in the Upper Left-hand Corner

D-1349 Studebaker Number

STARTING OF EMPLOYEE

INSTRUCTIONS:—Made out by Foreman and held as record until employee is disposed of.

NAME

ADDRESS

PHONE

WORKING AS A

PLANT DEPT.

DATE EMPLOYED

Fig. 5. Card on which a Foreman records Information about a New Employe

D-1349 Studebaker Number

DISPOSITION OF EMPLOYEE

INSTRUCTIONS:—Made in Original by Dept. Foreman and forwarded to Superintendent of Labor who will complete record.

Plant No. Dept. No Date

I am returning Mr.

Address

Who worked as

With the recommendation that he be { Finaled / Transferred

Ability { Excellent / Fair / Poor Conduct { Good / Agitator / Unreliable Production { Fast / Medium / Slow Rehire { Yes / No

Cause

Dept. Foreman

Transferred from Dept. No. as a

To Dept. No. as a

Finaled Trans.

Fig. 6. Reverse Side of Card in Fig. 5 on which Characteristics of Employe are noted

in Fig. 7. This form is also made in duplicate, the original being sent to the pay department for the issuance of a new clock number, then to the new foreman, who indicates the starting time thereon, after which it is taken by the representative of the cooperative department to the employment department. The duplicate is sent to the employment department, where it is retained until the receipt of the original, after which the original and duplicate are sent to the time and pay departments, respectively.

One of the most valuable records kept by the employment department is that of undesirable employes who have left or been discharged. This record is kept on small cards, filed by name in the office of the interviewer, and contains such information as the starting and leaving date, the reason for leaving, the department number, the foreman under which the employe worked, the rate of pay received, and whether the employe should be rehired or not. It is through the information on these cards that undesirable men are prevented from entering service a second time. Often a competent man without funds appears for employment, and to enable such a man to obtain immediate room and board, an order slip is given to him at the end of the first day. He signs this slip and turns it over to his boarding-house keeper, who presents it to the pay department and receives the amount of money indicated. This amount is subsequently deducted from the pay of the employe. This method has proved an aid to the acquisition of many a good man.

Examination of Employes

In the examination of an applicant, the greatest aid to the interviewer is the series of tests developed to check the actual ability of the applicant to do the task for which he applies. These tests were found necessary because of the costly mistakes made with the former method of briefly questioning an applicant, and they proved successful far beyond expectations. It is, of course, impossible to secure absolute perfection in work of this nature, yet the results have been most satisfactory. A test was made up for every class of work in the plant.

Owing to the labor shortage, it was necessary to determine with the greatest possible degree of accuracy, what each applicant was capable of doing, and to place him somewhere, even if he could not be used on the job for which he made application. To this end the tests were first made out to determine what an applicant was capable of doing. As these were used, revisions and additions were made until the tests served a fourfold purpose. First, they determined what the "floater" type was capable of doing or what he was interested in, so that he could be placed where his abilities, both natural and acquired, would be of the greatest value to himself and the firm. Second, they reduced the labor turnover, through a more careful placing of each applicant. Third, they placed an inexperienced applicant where he would find his natural abilities serving him to the greatest advantage. Fourth, they developed more responsible men.

The tests consisted of asking an applicant questions as to the operation of the type of machine he claimed to have had experience on, the manner in which various attachments are used, the way the machine should be set up for certain operations, the function of the different parts of the machine, and the names of some of the more important parts and units, as well as questions involving general mechanical knowledge in their answer. Photographs of the various types of machines were kept in the office of the interviewer for use in this connection. On some machines photographs were taken of disassembled units and parts for the same purpose. A set of qualifications was prepared for journeymen, to gage whether applicants were really proficient in their respective trades. Another list of questions dealt with the characteristics of the applicant, whether he spent any of his leisure time in studying to improve his abilities, and if not, how he did spend his evenings, etc.

These tests took a great deal of time to make out, verify, and revise, but as it was possible to pass upon at least double the number of applicants in the same time as before, and with greater accuracy, it proved to be an efficient means of employing men. No competent man has ever objected to such a test. On the other hand, he is eager to have the test made, feeling that he has a fair chance to prove his ability. It is the inexperienced man, realizing that he cannot convince the interviewer that he has the ability he claims to have, who objects to the examination.

W630 Studebaker

NOTICE OF EMPLOYEE'S TRANSFER

INSTRUCTIONS:—Made in duplicate by Co-operative Department upon the transfer of an employee fron one department to another. Original accompanies employee to Paymaster for new clock number and Three Day Pass and to Department Foreman as notice of transfer. Foreman indicates starting time hereon and hands to Co-operative Department representative who forwards to Employment Department. Employment Department retains duplicate until return of original from foreman, then copies starting time thereon and sends original to Time Department and duplicate to Paymaster.

Plant No.

Old Clock No.

New Clock No.

TO TIME OFFICE 19

We have transferred

FROM

Dept. No. Equip. No. As a

TO

" " " " " "

Signed

Employment Dept.

This employee started work in this Dept.

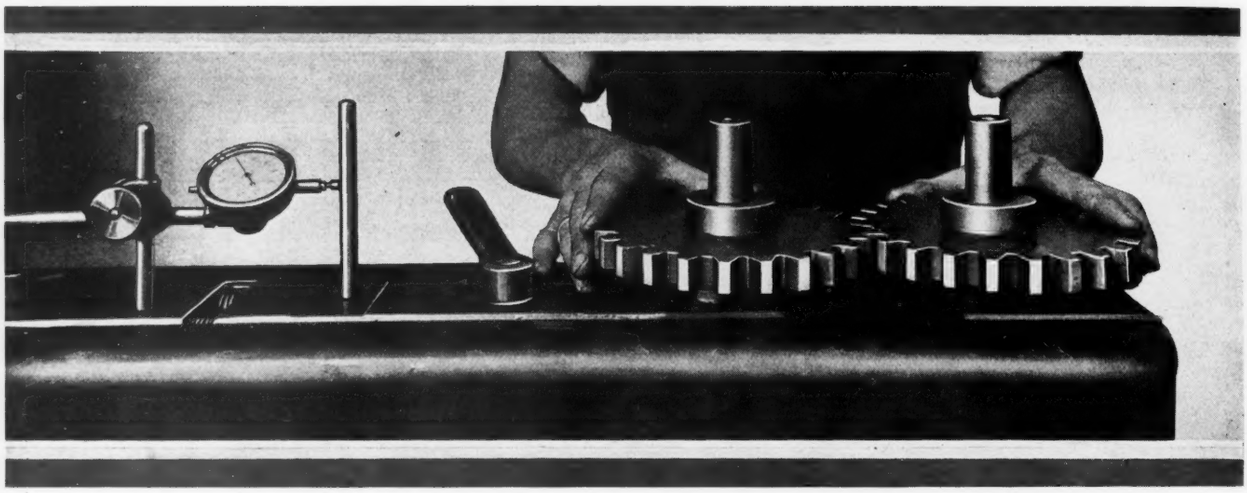
At A. M. / P. M. 192

Rate Charge Acc't

Signed

Foreman

Fig. 7. Transfer Notice made out by the Cooperative Department



Inspection of Involute Gear Hobs

Methods Used in Examining the Test Gears—Second of Two Articles

By CARL G. OLSON, Chief Engineer, Illinois Tool Works, Chicago, Ill.

TO transmit uniform rotary motion by gearing, the tooth curves of the gears must have definite theoretical forms, and in practice they must be made very nearly true to these forms. As the involute gear tooth system is the most flexible and the most convenient, it is being universally adopted; and hence we will limit our attention to the inspection of gears having involute teeth. The construction of the involute is well known, but to make this article complete, a reference to the theory will make the principle on which the testing machine operates clearer.

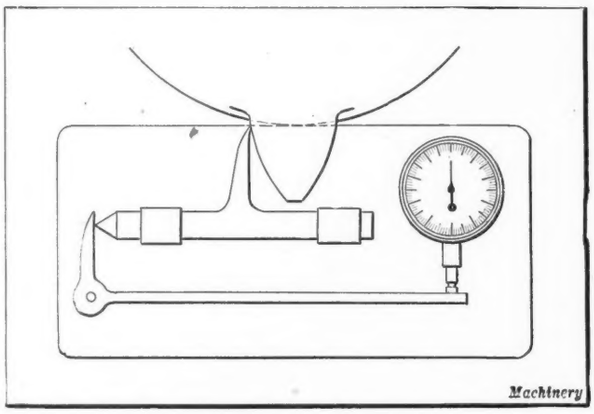


Fig. 1. Involute Testing Machine

The Involute Test

The tooth curve as shown in Fig. 2 is traced by a point in a string unwinding from a cylinder; and in Fig. 3 an equal line is traced by a point in a tangent rolling on a cylinder without slipping. The fixture shown diagrammatically in Fig. 1, and in Figs. 4 and 5, is constructed on the foregoing theory. The base circle is here represented by a disk, and the tangent by one edge of a flat block on which is mounted an indicator terminating in a contactor point located in the plane of the tangent.

The base disks must be of accurate diameters, and these are governed by the number of teeth, and by the pitch and the pressure angle of the gears. A formula for figuring these diameters is given in connection with the accompanying tables of base disk diameters for common sizes and pitches of gears. A groove in the center of the face of the disks is made to accommodate a wire, and it should be of a depth equal to one-half of the diameter of the wire that is used. The edge of the indicator block has a corresponding groove of the same depth as the groove in

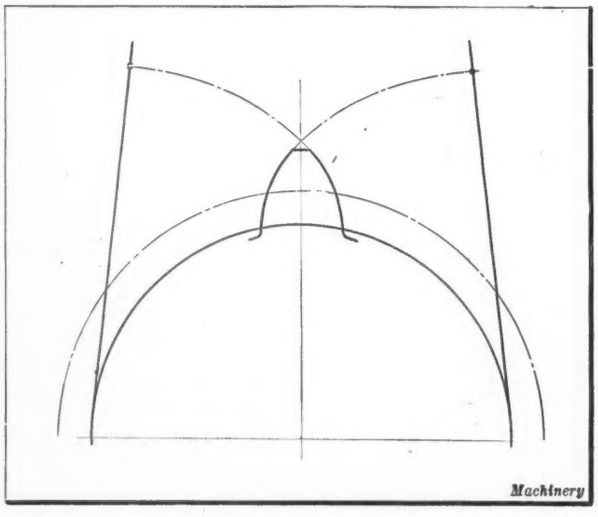


Fig. 2. Involute Curve traced by a Point in a String while unwinding from a Cylinder

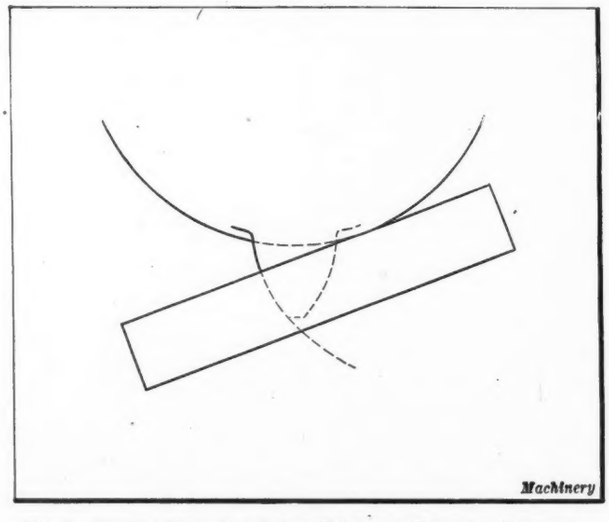


Fig. 3. Involute Curve traced by a Point in a Tangent rolling on a Cylinder

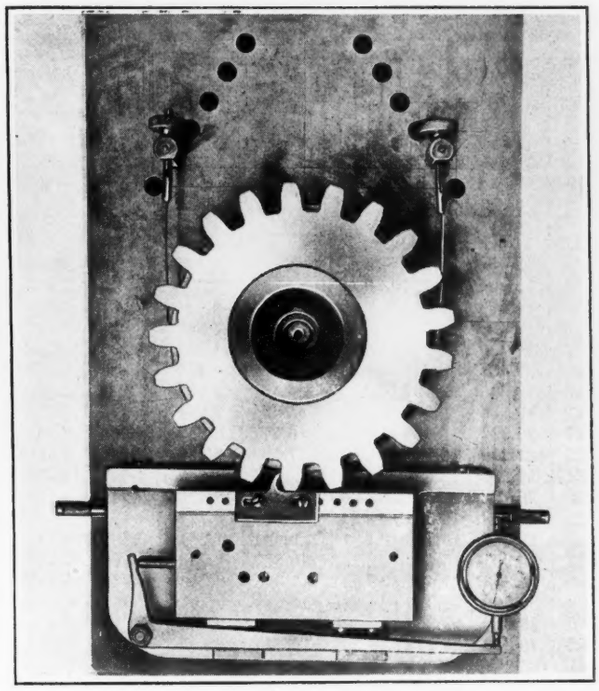


Fig. 4. Testing the Involute Tooth Form of a Spur Gear

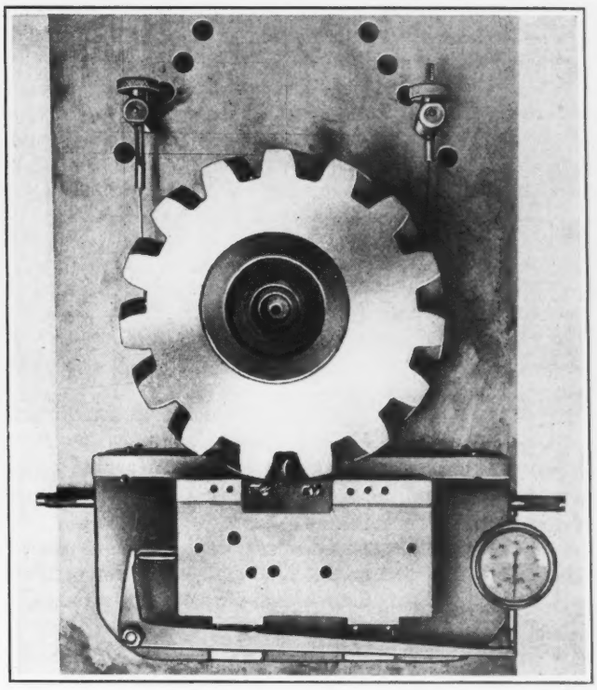


Fig. 5. Testing the Involute Tooth Form of a Helical Gear

the disks. This allows the tangent to roll directly on the base disk, and by having one half the wire in each member, no slipping takes place from the bending of the wire.

To make a test of a gear, the correct base disk is selected and placed on the stud in the table of the machine, after which a spacing collar and the gear to be tested are put in place. The wire bands are then adjusted and tightened. The gear is turned until the face of one tooth acts on the contactor, turning the indicator pointer about one half revolution, when the gear and base disk are locked together with a hand-nut on the stud. The block is rocked on the base disk, allowing the contactor to follow the involute tooth face, while the deflection of the indicator is noted.

If the involute is perfectly true, there will be no deflection of the indicator pointer, but such perfection is hard to obtain. In practice, it has been found that a variation of a fraction of a thousandth inch is not noticeable in the running of the gears.

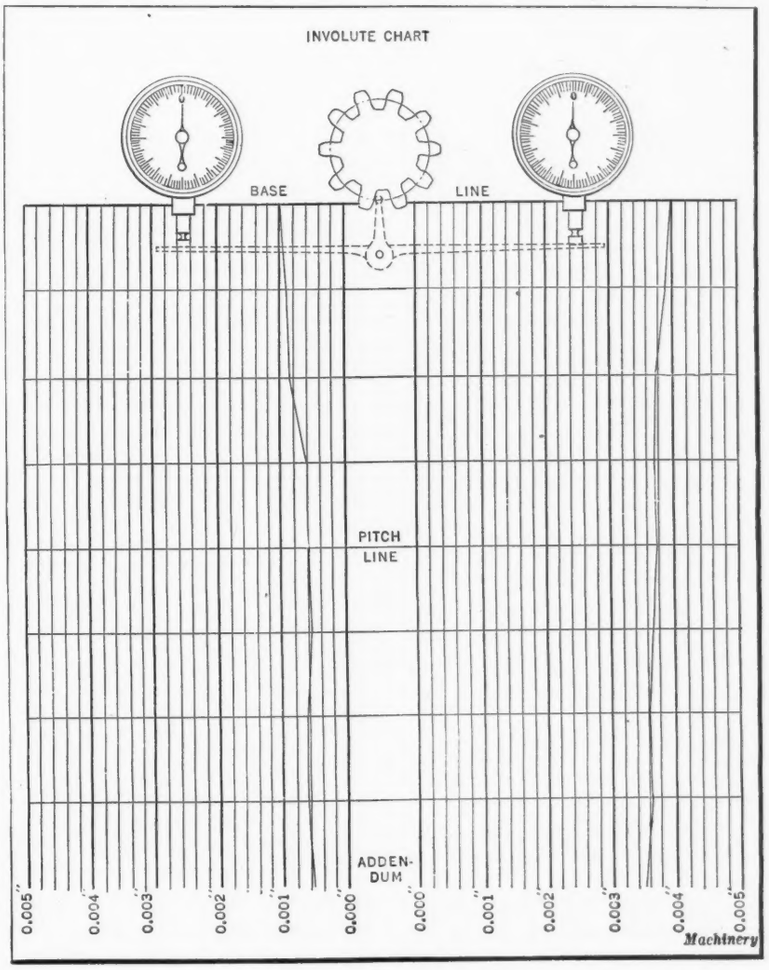


Fig. 6. Chart for recording Results of Involute Gear Tests made on Machine shown in Figs. 4 and 5

The deflection may be recorded in a diagram of the form shown in Fig. 6. The main divisions formed by the vertical lines indicate 0.001 inch, and the horizontal spacing divides the tooth face into eight main divisions headed by the base line, from which the curve is started downward to the pitch line and the addendum line. The base line and the pitch line should be indicated on the gear, but the other lines may be approximated for all practical purposes.

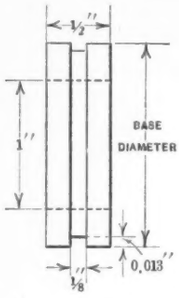
The Jump Test

One of the commercial methods of testing gears is the so-called "jump test," which consists of placing the gears on a gear-testing machine, provided with suitable studs, one of which is mounted in a sliding part acted upon by a spring that tends to force the gears together. An indicator is affixed to the machine in such a manner that it will show the movement of the sliding part and stud when the gears are gently rolled by hand, measuring the "jump" as each pair of teeth meshes. This apparatus is shown

in the heading illustration. The maximum tolerance of jump in commercial gears should not exceed 0.010 inch divided by the diametral pitch of the gears.

Dependence cannot be placed upon the jump test for gears that have backlash, because the thin teeth will not roll tightly at the proper center distance, and a closer center distance will not generally show the true condition. To detect the run-out or the eccentricity of the pitch lines, the gears are turned through a complete revolution, but this test does not refer to the correctness of the hob with which the teeth were cut. However, it shows if the gears were carefully hobbed. The gear-testing machine should be provided with means for accurately measuring the center distance of the gears and means for locking the studs while making roll tests and when checking the backlash.

TABLE 1. BASE CIRCLE DISK DIAMETERS
For Testing the Involute Curve on the Testing Machine



The base diameter is equal to the pitch diameter multiplied by the cosine of the pressure angle.

Formula: $BD = PD \times \cos PA$

The depth of the groove is equal to one half of the diameter of the band or wire used on the testing machine.

No. of Teeth	20-degree Pressure Angle					
	Diametral Pitch					
	4–5	5–7	6–8	8–10	10–12	12–14
12	2.819	2.255	1.879	1.410	1.128	0.940
13	3.054	2.443	2.036	1.527	1.222	1.018
14	3.289	2.631	2.193	1.645	1.316	1.096
15	3.524	2.819	2.349	1.762	1.410	1.175
16	3.759	3.007	2.506	1.879	1.504	1.253
17	3.994	3.195	2.662	1.997	1.598	1.321
18	4.229	3.383	2.819	2.114	1.691	1.420
19	4.464	3.571	2 976	2.232	1.785	1.488
20	4.698	3.759	3.132	2.349	1.879	1.566
21	4.933	3.945	3.289	2.467	1.973	1.644
22	5.168	4.135	3.445	2.584	2.067	1.723
24	5.638	4.511	3.759	2.819	2.255	1.879
26	6.108	4.886	4.072	3.054	2.443	2.035
28	6.578	5.262	4.385	3.289	2.631	2.193
30	7.048	5.638	4.698	3.524	2.819	2.349
32	7.518	6.014	5.012	3.759	3.007	2.506
36	8.457	6.766	5.638	4.229	3.383	2.819
38	8.927	7.142	5.931	4.464	3.571	2.976
40	9.397	7.518	6.265	4.698	3.759	3.132
42	9.867	7.893	6 578	4.933	3.947	3.289
44	10.337	8.269	6.891	5.168	4.135	3.446
46	10.809	8.645	7.204	5.403	4.323	3.602
48	11.276	9.021	7.518	5.638	4.511	3.759
50	11.746	9.397	7.831	5.873	4.698	3.915
52	12.216	9.773	8.144	6.108	4.886	4.072
56	13.156	10.523	8.770	6.578	5.262	4.385
60	14.095	11.276	9.397	7.038	5.638	4.698

Machinery

The Roll Test

When placed on the studs of this machine and adjusted to the proper center distance, the gears should roll without interference and without any noticeable interruption when passing from tooth to tooth, when they are gently rolled by hand with the tooth faces pressed together while rolling. The bearing or rolling contact is carefully noted. To make the bearing show up plainly, the surfaces of the gear teeth may be coated with a thin film of red lead and oil.

The ideal bearing is uniform over the greater part of the face of the teeth, blending gradually out at a point slightly inside the addendum circle. This blending is called the "approach curve" and should be very slight in the case of gears that are not to be heat-treated after hobbing; but in gears that will be subjected to a process of heat-treatment, and, therefore, to a possible slight distortion, this curve should be greater to allow more flexibility in the assembling of gear trains. It has been found that by making liberal approach curves in the tooth profiles of heat-treated gears, rejections due to noisy running have been greatly reduced.

TABLE 2. BASE CIRCLE DISK DIAMETERS
For Testing the Involute Curve on the Testing Machine

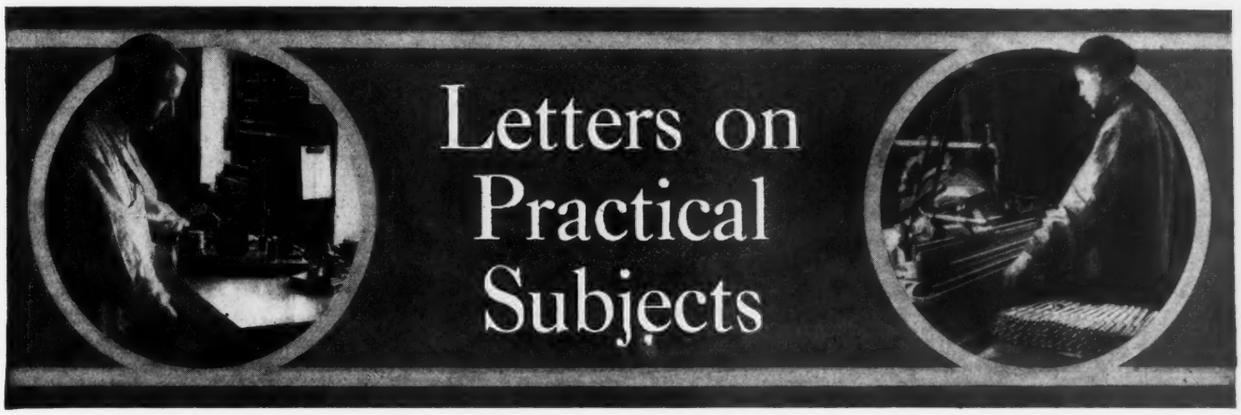
No. of Teeth	14½-degree Pressure Angle						
	Diametral Pitch						
	1	2	2½	3	4	5	6
12	11.618	5.809	4.647	3.873	2.905	2.324	1.936
13	12.586	6.293	5.134	4.195	3.147	2.517	2.098
14	13.554	6.777	5.422	4.518	3.389	2.711	2.259
15	14.523	7.261	5.809	4.841	3.631	2.904	2.420
16	15.490	7.745	6.196	5.163	3.873	3.098	2.582
17	16.459	8.229	6.583	5.486	4.115	3.292	2.743
18	17.427	8.713	6.971	5.809	4.357	3.485	2.905
19	18.395	9.197	7.358	6.132	4.599	3.679	3.066
20	19.363	9.682	7.745	6.454	4.841	3.873	3.227
21	20.331	10.166	8.132	6.777	5.083	4.066	3.389
22	21.299	10.650	8.519	7.100	5.325	4.260	3.550
24	23.236	11.618	9.294	7.745	5.809	4.647	3.873
26	25.172	12.586	10.069	8.391	6.293	5.034	4.195
28	27.108	13.554	10.843	9.036	6.777	5.422	4.518
30	29.045	14.523	11.618	9.681	7.261	5.809	4.841
32	30.981	15.490	12.392	10.327	7.745	6.196	5.163
36	34.853	17.427	13.941	11.618	8.713	6.971	5.809
38	36.790	18.395	14.716	12.263	9.197	7.358	6.132
40	38.726	19.363	15.490	12.909	9.682	7.745	6.454
42	40.662	20.331	16.265	13.554	10.166	8.133	6.777
44	.....	21.299	17.039	14.199	10.650	8.520	7.100
46	.....	22.267	17.814	14.845	11.134	8.906	7.423
48	.....	23.236	18.588	15.490	11.618	9.294	7.745
50	.....	24.204	19.363	16.136	12.102	9.682	8.068
52	.....	25.172	20.138	16.781	12.586	10.069	8.391
56	.....	27.108	21.687	18.072	13.554	10.843	9.036
60	.....	29.045	23.236	19.363	14.522	11.618	9.681

Machinery

TABLE 3. BASE CIRCLE DISK DIAMETERS
For Testing the Involute Curve on the Testing Machine

No. of Teeth	14½-degree Pressure Angle						
	Diametral Pitch						
	7	8	9	10	12	14	16
12	1.660	1.452	1.291	1.162	0.968	0.830	0.726
13	1.798	1.573	1.398	1.259	1.049	0.899	0.787
14	1.936	1.695	1.506	1.355	1.130	0.968	0.847
15	2.075	1.815	1.614	1.452	1.210	1.037	0.908
16	2.213	1.936	1.721	1.549	1.291	1.106	0.968
17	2.351	2.057	1.829	1.646	1.372	1.176	1.029
18	2.490	2.178	1.936	1.743	1.452	1.245	1.089
19	2.628	2.299	2.044	1.840	1.533	1.314	1.150
20	2.766	2.420	2.151	1.936	1.614	1.383	1.210
21	2.904	2.541	2.259	2.033	1.694	1.452	1.271
22	3.043	2.662	2.367	2.130	1.775	1.521	1.331
24	3.319	2.905	2.582	2.324	1.936	1.660	1.452
26	3.596	3.147	2.797	2.517	2.098	1.798	1.573
28	3.873	3.389	3.012	2.711	2.259	1.936	1.694
30	4.149	3.631	3.227	2.905	2.420	2.075	1.815
32	4.426	3.873	3.442	3.098	2.582	2.213	1.936
36	4.979	4.357	3.873	3.485	2.905	2.490	2.178
38	5.256	4.599	4.088	3.679	3.066	2.628	2.299
40	5.532	4.841	4.303	3.873	3.227	2.766	2.420
42	5.809	5.083	4.518	4.066	3.389	2.904	2.541
44	6.086	5.325	4.733	4.260	3.550	3.043	2.662
46	6.362	5.567	4.948	4.454	3.711	3.181	2.783
48	6.639	5.809	5.163	4.647	3.873	3.319	2.905
50	6.915	6.051	5.379	4.841	4.034	3.458	3.026
52	7.192	6.293	5.594	5.034	4.195	3.596	3.147
56	7.745	6.777	6.024	5.422	4.518	3.873	3.389
60	8.298	7.261	6.454	5.809	4.841	4.149	3.631

Machinery



DRESSING WHEELS FOR CONCAVE AND CONVEX GRINDING

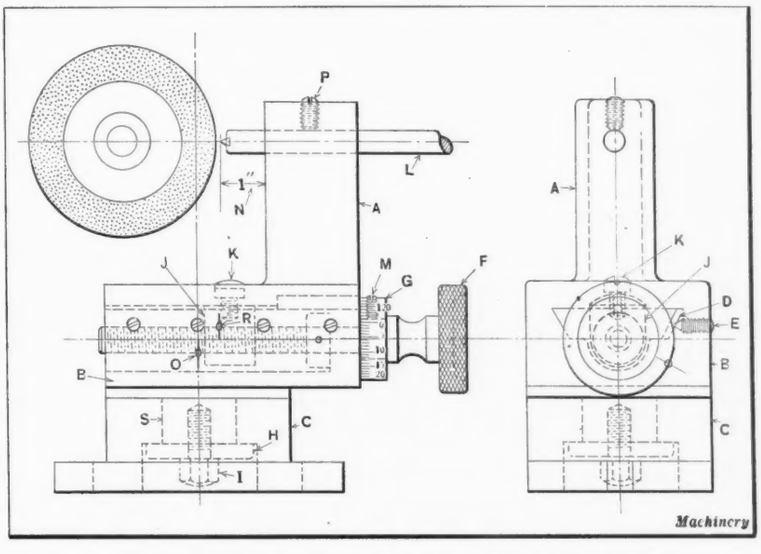
The attachment shown in the accompanying illustration was designed by the writer for use on a universal grinding machine. With it the periphery of the grinding wheel can be given either a concave or a convex form, of any radius within the range of the attachment. This device eliminates the necessity of dressing the wheels with a hand-dresser to conform to a radius gage. The principal parts of the attachment are the diamond-point wheel-dresser holder *A*, which is held to the angular dovetail of saddle *B* by means of gib *D* and screws *E*. Saddle *B* is, in turn, attached to base *C* by means of cap-screw *I* located in the shank *S* of part *B*. Shank *S* acts as a pivot around which part *B* swivels.

Holder *A* can be adjusted on saddle *B* by means of a knurled-head screw *F*, which fits into nut *J* attached to *B* by cap-screw *K*. Screw *F* has an 8-pitch thread, and is provided with a dial *G* having 125 division lines, each representing a movement of the holder *A* of 0.001 inch. Dial *G* is a loose fit on screw *F*, but can be held firmly to it by tightening screw *M*. This attachment has a range for truing wheels up to 6 inches in diameter, and can be used to give the periphery of a wheel either a concave or a convex surface of any radius up to 1¾ inches. The device has been tried out in practice, and has given satisfactory results.

In dressing a grinding wheel to a given radius, the device is mounted on the grinding machine table and a diamond-point wheel-dresser inserted in holder *A*. This holder is advanced through the hole until the diamond point projects one inch from the face of the holder, as indicated by the dimension at *N*. Screw *P* is next tightened and dimension *N* checked with a gage. The knee of the grinding machine is then raised until the diamond point is in line with the center of the grinding wheel spindle. The knurled-head screw *F* is then turned until line *R* on the holder *A* coincides with line *O* on the saddle *B*.

This adjustment brings the diamond point directly over the center lines of pivot *S*. Dial *G* is then adjusted until the two zero lines coincide, after which screw *M* is tightened to hold the dial in place. Adjusting screw *F* is then turned until the reading of the dial shows that the device is properly set to true the wheel to the required radius. The wheel is trued by swinging the holder *A* about pivot *S*, the machine being adjusted, of course, to bring the diamond truing point into proper contact with the periphery of the wheel.

Conneaut, Ohio F. A. Gross



Attachment for dressing Concave and Convex Form-grinding Wheels

FASTENING PAPER TO DRAWING-BOARD

In making large lay-out drawings that require considerable time to finish, the use of thumb-tacks for fastening the paper to the board is unsatisfactory, especially if the lay-out is to be traced, because the paper is sure to stretch and form ridges between the tacks. A good way to keep the paper flat and avoid the annoyance caused by the triangles or drafting machine coming in contact with the thumb-tacks, is to mount the paper on the board in the following manner: Cut the paper, either a heavy grade of detail paper or "Whatman's Hot Pressed" about 4 inches longer each way than the finished tracing, and use a drawing-board the same size or a little larger than the lay-out paper. After the paper is cut, turn up the four sides about 2 inches from the edge without cutting the corners, and remove any dirt or grease that may have accumulated on the part of the board which is to be covered by this 2-inch margin.

On the inside of this turned-up portion apply a coating of some good library or photographic paste, thinned out with water to about the consistency of liquid glue. Wet the side of the paper on which the paste has been applied with a sponge inside the border of paste. Then place the wet side of the paper on the board and press the upper edge down. Then gently pull the paper out as flat as possible and press the other three edges down smooth. When the paste has taken a good hold on the board, wet the upper face of the paper. The water should not be applied to the portion of the paper directly over the pasted margin; the ridge formed by turning up the edge of the paper for pasting will serve as a guide. Now press down the edges several times with some

hard, smooth object, such as the back of a pocket knife, to remove any air bubbles which may be left in the pasted surface.

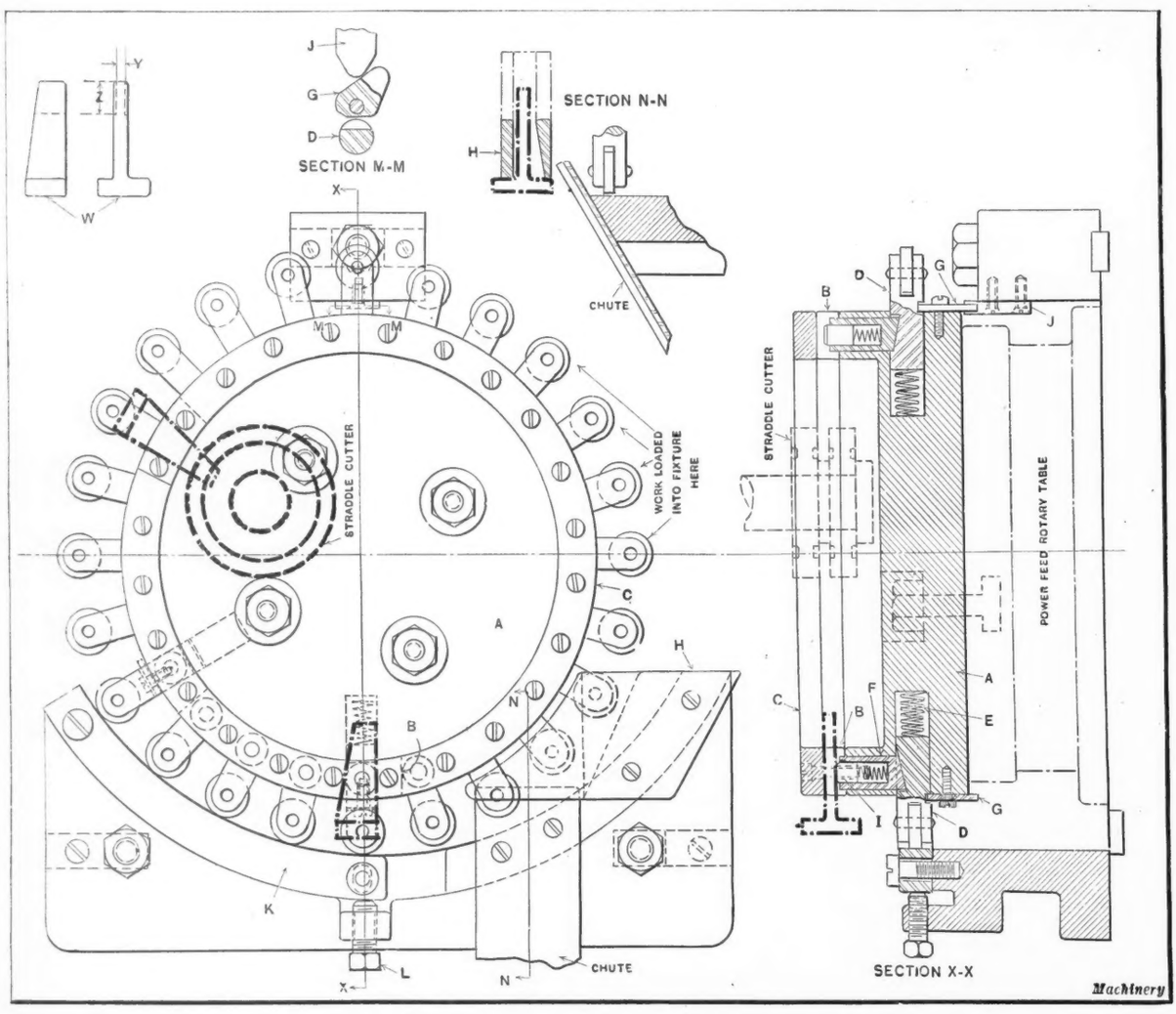
If the surface of the paper begins to dry in spots, wet the portions that are drying too rapidly so that the entire surface will become dry about the same time. When the paper is thoroughly dry, it will be flat and ready for use. If it is necessary to preserve the lay-out after it has been taken from the board, the drawing should not extend over the pasted border. The writer has found it advisable to stretch the paper down before the end of the day's work so that no time will be lost waiting for the paper to dry. After the lay-out has been traced, cut the paper inside the pasted margin and remove the paper left on the board by rubbing with emery cloth or sandpaper.

Philadelphia, Pa. WALTER A. TEGLER

There are a number of holes drilled radially in base *A*, to receive springs *E* and plungers *D*. Clamp *F*, riding on a bevel on plunger *D*, clamps the work against ring *C* by the pressure of spring *E*. The spring in clamp *F* releases it from the work when the plunger *D* is forced in. Stop *G*, engaging in a slot in the under side of plunger *D*, holds spring *E* in check, keeping clamp *F* released as shown.

Unloading is accomplished by the ejector *H*. As the fixture is revolved, the head of the work hooks into the ejector, which draws it out until it is entirely clear of the clamp, whereupon it overbalances and falls into a chute, which delivers it to a receptacle provided for that purpose. In manipulating this fixture, the operator loads the work into the fixture as the parts are ejected. The auxiliary spring-actuated plunger *I* holds the work in position until clamped.

As the fixture rotates, trip-pin *J* trips stop *G* and releases



Milling Fixture with Automatic Clamping and Ejecting Devices

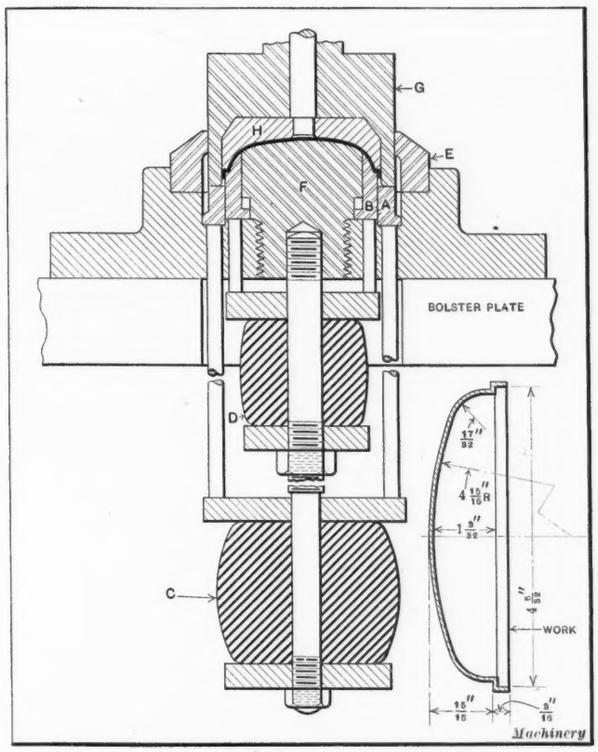
MILLING FIXTURE FOR CONTINUOUS CIRCULAR MILLING

A continuous circular milling fixture for use on a vertical milling machine is shown in the accompanying illustration. This fixture was designed for straddle-milling the ends of aluminum castings such as shown at *W*. The end of the work was required to be machined to a thickness *Y*. As a large number of these parts are used, the fixture was designed for rapid production. The whole fixture comprises the fixture proper, the clamping and releasing members, and the work-ejecting device. The fixture proper is bolted to a standard power-feed rotary milling table. To base *A*, is screwed and doweled the steel ring *C* and spacing blocks *B*. The latter serve also as gage-blocks to locate the work on the tapered side.

plunger *D* which clamps the work while it is carried past the cutter. In unclamping, plungers *D* (which have rollers mounted on them to minimize friction) are forced in by cam *K* until the slots on the bottoms of the plungers allow stops *G* to return to their normal positions, thus holding the plungers in check after they have cleared the cam.

The clamping pressure can be regulated by using a small or a large bevel on plunger *D*. The set-screw *L* is used for adjusting cam *K* after the fixture has been set up. The cutter should be set in a fixed position, a little beyond the point at which trip *J* releases plunger *D*. The dimension *Z* on the work was not required to be held to close limits of accuracy in this particular case, but when necessary, special provision can be made for locating the work radially with greater accuracy.

Brooklyn, N. Y. LESTER FERENCI



Punch and Die Construction permitting the Completion in One Operation of Parts generally produced by Two Dies

DIE WITH TWO DRAWING RINGS

Two distinct drawing operations on power presses are commonly employed in the production of parts which can be just as satisfactorily drawn in one operation by means of a punch and die construction similar to that shown in the accompanying illustration. This punch and die is used for drawing oil-can breasts to the shape and dimensions shown in the lower right-hand corner. The development of a die for producing this part in one operation was difficult because of the shoulder near the open end and the thinness of the metal from which the part is drawn, this metal being cold-rolled stock, 0.024 inch in thickness. The blank diameter is 5 3/32 inches. The special feature of this die is the provision of two drawing rings, one inside the other, against which upward pressures are exerted by means of two separate rubber buffers.

The illustration shows the relation between the punch and the moving members of the die at the completion of a downward stroke of the press ram. Prior to a descent of the punch, drawing rings *A* and *B* are in raised positions due to the pressure exerted by rubber buffers *C* and *D*, respectively. The pressure of each buffer is transmitted to the bottom of its respective drawing ring through the medium of a plate and two round rods. When ring *A* is in the raised position, its upper surface coincides with that of the blanking ring *E*. The raised position of ring *B* is such that the top of the ring does not project beyond the highest point of center plug *F*.

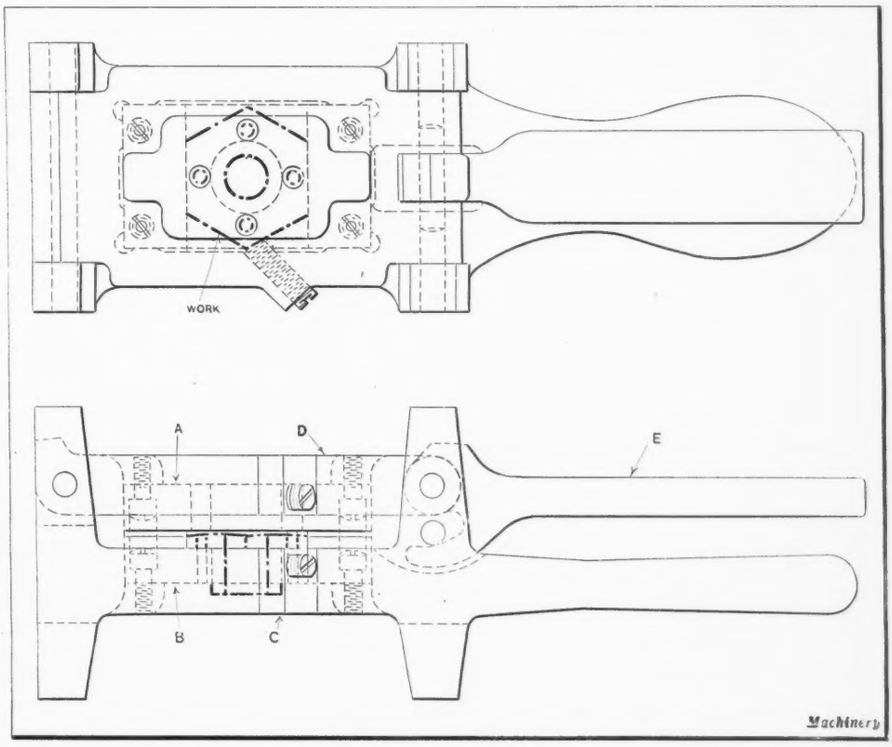
The strip of metal from which a part is to be drawn is laid on the upper edge of ring *E*, and blanked to size as punch *G* enters this ring, pressure being exerted against the blank by drawing ring *A* in the manner previously described. The blank and ring *A* are pushed into the die as the punch continues to descend, while ring *B* remains stationary for a moment due to the pressure of buffer *D*. The result is that the edge of the blank is turned down around ring *B*. This ring is pushed downward after section *H* of the punch comes in contact with the blank, the latter being stretched on plug *F* and ring *B*, and the shoulder being formed. By stretching the metal in this manner all wrinkles are eliminated on the drawn part, so that subsequent spinning or restriking is unnecessary.

The completed part is forced from the die on the upward stroke of the press ram by rings *A* and *B* as they resume their normal positions. In case the part adheres to the ascending punch it is ejected from this member by section *H* which, in addition to its function of shaping the shell, also serves as a knock-out pad. If the die for making this part was of the common design, drawing ring *B* would be integral with plug *F* and so it would be practically impossible to draw a shell without wrinkles. The top edge of ring *B* is rounded, so that the blank is not cut through when it is forced upon the ring.

Toledo, Ohio J. BINGHAM

INTERCHANGEABLE-PLATE JIG FOR SMALL PARTS

In shops where a large variety of small parts must be drilled and a jig used for the operation in each case, obviously a considerable investment is involved for the jigs alone, and if it were possible to employ the same jig in a number of cases by simply substituting one or two members to suit the work, drill jig costs might be greatly reduced. With this end in view, the jig shown in the accompanying illustrations was designed. This jig has an upper plate *A* and a lower plate *B*, each of which is replaceable to suit a



Drill Jig designed to accommodate a Large Variety of Work, being provided with Interchangeable Plates to suit Each Part

large number of parts of different shapes. In the illustration the plates are those employed in drilling and tapping four holes through the hexagonal head of a small part, the work being located by means of a recess in the lower plate.

Both plates may be provided with bushings so that operations can be performed from both sides of the work. In many cases, the holes are drilled from one side, and then tapped, countersunk, or counterbored from the other. Bushings may often be eliminated by hardening the plates. The latter are located along one side and one end by accurately machined surfaces on the jig body *C* and leaf *D*, against which the plates are forced by means of two screws. With this arrangement, it is unnecessary to fit the plates in the jig. It will be seen that the plates are attached to the leaf and body, respectively, by means of four fillister-head machine screws. The holes for these screws are located from a jig so that the plates for the various pieces of work will be interchangeable. The body and leaf are steel castings, and the work is clamped in the plates by means of cam-lever *E*. This jig may be made in a number of sizes.

Cleveland, Ohio A. J. CAYOUETTE

BORING-BARS FOR DOUBLE-END CUTTERS

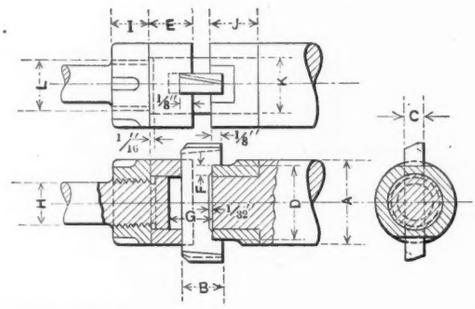
The two types of boring-bars here shown were designed as a result of the demand for boring-bars which would hold double-end cutters, and give the maximum length of service when used with a milling or boring machine or in connection with boring fixtures, for the production of duplicate machine parts requiring a high degree of accuracy. The writer has found these boring-bars to be superior to those frequently used, which have a machine steel or soft tool steel bar for holding the hardened cutter. With boring-bars of the latter type it is often found that, after a very few cuts and changes of cutters have been made, the driving of the taper wedge—usually employed to hold the cutters in place—as well as the thrust on the cutters due to the cutting action tends to peen the bars under the angular or flat centering shoulders, thus making the cutters loose in the bar and impairing the accuracy of the tool to such an extent that new bars or cutters are required.

Boring-bars of improved construction, such as shown in Table 1, are intended for boring blind holes, where the bar is supported by a follow-up bushing behind the cutter. The cutter is made with a centering shoulder on each side. These shoulders are turned on centers so that they will fit the inside bores of the two hardened and ground collars. The collar on the inner side is made a tight fit on the bar, and the outer collar is made a good slip fit to facilitate the changing of cutters. The combination of cutter and collars is clamped tight by means of the nut on the threaded end. The outside diameter of the cutter can be ground to size when held on centers or while in position in the bar.

In a boring-bar of the construction indicated in the illustration shown in connection with Table 2, where the bar is supported on both sides of the cutter in a fixture and driven by a universal joint arrangement, it is desirable that the diameter *H* be made as large as is consistent with good practice. In this construction two hardened and ground collars are used and the cutter is centralized by the usual flat shoulder supported on the flats of the inside collar which is tight on the bar. The cutter diameter is ground to size in a suitable fixture or while in position in the bar. Boring-bars that are made in accordance with the dimensions given in the accompanying tables have been found very satisfactory, their additional first cost being more than compensated for by their greater accuracy, dependability, and length of life.

Waterbury, Conn. ALBERT H. GAESS

TABLE 2. DIMENSIONS FOR BORING-BAR HEADS

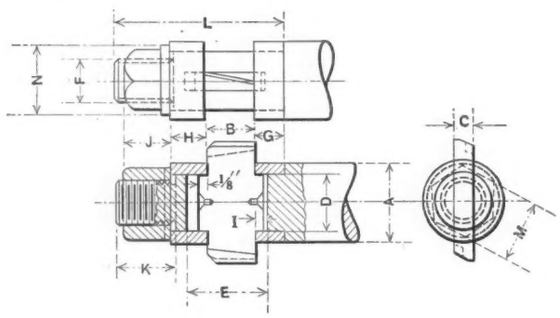


All dimensions in inches

A	B	C	D	E	F	G	H	I	J	K	L
1¼	¾	3/16	1 3/16	9/16	1/8	13/16	5/8	11/16	9/16	13/16	¾
1½	⅞	¼	1 7/16	5/8	5/32	15/16	⅞	¾	5/8	1	1
1¾	1 3/16	5/16	1 11/16	11/16	5/32	1¼	15/16	13/16	11/16	1 3/16	1⅛
2	1 3/16	5/16	1 15/16	¾	5/32	1¼	1 5/16	15/16	¾	1⅜	1⅜
2¼	1¼	5/16	2 3/16	13/16	3/16	1 5/16	1⅜	1	13/16	1⅝	1⅝
2½	1½	⅜	2 7/16	⅞	3/16	1 9/16	1½	1 1/16	15/16	1 13/16	1¾
2¾	1½	7/16	2 11/16	15/16	¼	1 9/16	1¾	1 3/16	1	2	2
3	1½	7/16	2 15/16	1	¼	1 9/16	1⅞	1¼	1 1/16	2⅛	2⅛
3¼	1½	7/16	3 5/32	1 1/16	¼	1 9/16	2⅛	1⅜	1⅛	2⅜	2⅜
3½	1½	½	3 13/32	1⅛	5/16	1 9/16	2 3/16	1½	1 3/16	2 9/16	2½
4	1½	½	3 23/32	1¼	⅜	1 9/16	2⅝	1⅝	1⅜	3	3
4½	1 11/16	5/8	4 3/8	1⅜	½	1¾	3	1 13/16	1½	3⅜	3⅜
5	1 11/16	5/8	4 7/8	1½	½	1¾	3 5/16	2	1⅝	3¾	3¾

Machinery

TABLE 1. DIMENSIONS FOR BORING-BAR HEADS



All dimensions in inches

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	5/8	5/32	5/8	1 1/16	9/16	9/16	5/8	5/32	9/16	11/16	2 7/16	⅞	31/32
1¼	¾	3/16	13/16	1 3/16	5/8	5/8	11/16	5/32	¾	⅞	2 13/16	1 1/16	1 3/16
1½	⅞	¼	1	1 5/16	⅞	11/16	¾	5/32	⅞	1	3¼	1¼	1 7/16
1¾	⅞	¼	1 3/16	1 5/16	1	¾	⅞	5/32	1 1/16	1 3/16	3 5/8	1½	1 11/16
2	1 3/16	5/16	1⅜	1⅝	1¼	13/16	1 5/16	5/32	1⅛	1 5/16	4 3/16	1¾	1 15/16
2¼	1¼	5/16	1⅝	1¾	1½	⅞	1	3/16	1 5/16	1 7/16	4½	1⅞	2 3/16
2½	1½	⅜	1 13/16	2	1⅝	1	1⅛	3/16	1½	1 11/16	5¼	2⅛	2 7/16
2¾	1½	7/16	2	2	1¾	1 1/16	1 3/16	3/16	1⅝	1 13/16	5½	2⅜	2 11/16
3	1½	7/16	2 3/16	2	1⅞	1⅛	1¼	3/16	1 13/16	2	5 13/16	2⅝	2 15/16
3¼	1½	7/16	2⅜	2	2⅛	1 3/16	1 5/16	3/16	1 15/16	2 1/16	6⅛	2¾	3 3/16
3½	1½	½	2 9/16	2	2¼	1¼	1 7/16	3/16	2⅛	2 5/16	6 7/16	3	3 7/16
4	1½	½	2 13/16	2	2½	1⅝	1 9/16	3/16	2⅜	2 9/16	6 15/16	3⅜	3 11/16
4½	1 11/16	5/8	3⅜	2 3/16	2¾	1½	1¾	3/16	2 11/16	2⅞	7¾	3⅞	4 7/16
5	1 11/16	5/8	3¾	2 3/16	3	1⅝	1⅞	3/16	3	3 3/16	8 5/16	4¼	4⅞

Machinery

HARDINGE OIL BURNER FOR INDUSTRIAL PLANTS

Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago, Ill., have developed a new type of oil burner known as the Hardinge oil burning machine. This equipment is constructed to burn all kinds of fuel oil, from the heavy low-grade Mexican product to the better grade of kerosene. Some of the important features incorporated in this oil burning machine are the provision of an atomizer and agitator, which treat the oil before burning; a revolving needle in the oil-feed valve which feeds the oil in small regular quantities; a pressure chamber which eliminates air and water bubbles; an air regulator which regulates the air mixture; an automatic stop which stops the machine and prevents flooding if the fire accidentally goes out; a convenient method of cleaning the burner; and an oiling system for the atomizer spindle. These features make it possible to burn ordinary fuel oil economically without objectionable noise, odor, or dirt.

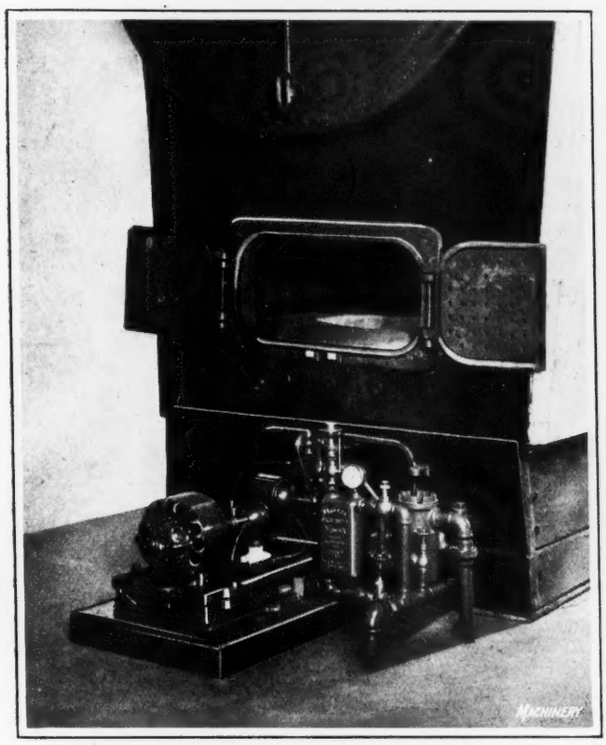


Fig. 1. Hardinge Oil Burner applied to Boiler

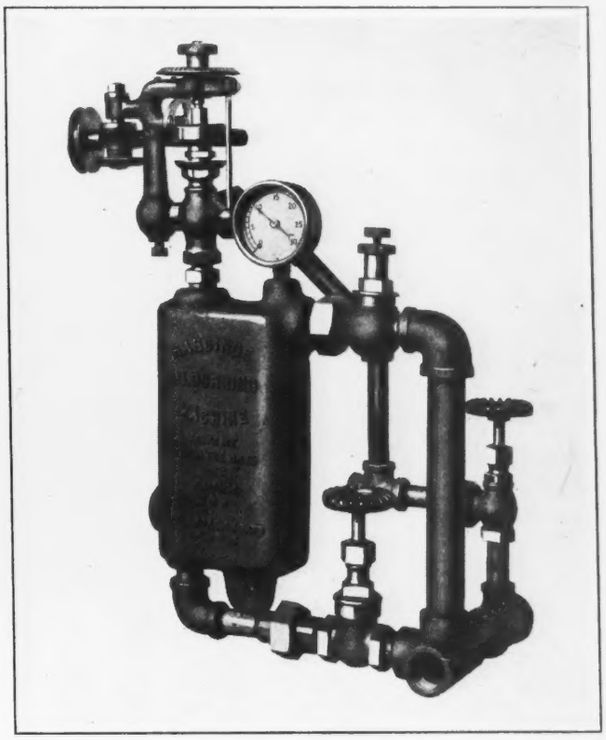


Fig. 2. Valve Control Unit of Hardinge Oil Burner

The machine can be adapted to heating systems of small residences as well as to the heating of boilers in large industrial plants, and is equally applicable whether the problem is one of heating or of generating steam for motive power. The burner is always under control and has a wide range of adjustment. For instance, in the case of an installation in the heating system of a small residence, it is possible to turn the flame down so low that only one half a gallon of fuel oil will be consumed per hour. A good idea of the relative size and location of the oil burning machine as applied to the heating of a boiler may be obtained by referring to Fig. 1. In Fig. 2 is shown a close-up view of the control unit by means of which the fire is controlled.

Operation of Burner

The oil is drawn from the supply tank (which is usually placed under the floor) up through the strainer by a pump driven by an electric motor, as shown in Fig. 1, which also serves to drive the rotating members of the burners. From the pump the oil is forced into a chamber where it is kept under pressure by the pump. It next passes upward through a revolving needle valve seat which regulates the quantity of oil to be burned. From this point it follows the pipe line up to the openings of a short standpipe. It then flows downward through the bottom of the revolving cup of an atomizer where it is thrown off through the oil-tube by centrifugal force. This rotating oil-pipe is held in a bearing located under the burner. An agitator at the bottom of the cup keeps the oil constantly emulsified.

Dirt, water, and other substances are separated from the oil during its passage upward through the cup, according to their specific gravities. The oil next passes over the atomizer into the firebox. The dirt, water, and other substances that are heavier than the oil constantly pass off under the oil and are consumed. This constant treatment of the oil eliminates all possibility of dirt accumulating in the pipe system.

The only place where any dirt can collect is on the convex curve of the atomizer bell, and this is cleaned by the simple process of drawing a small steel poker over the bell surface while the machine is in operation. A small size burner need not be cleaned oftener than once in two weeks, while a commercial burner may require cleaning once a week. The cleaning operation can be done in less than a minute while the fire is burning. As the oil leaves the bell-shaped atomizer it is thrown by centrifugal force into the firebox.

* * *

ELECTRIC ARC WELDING WITH CARBON ELECTRODES

In the first paragraph of the article on electric arc welding, appearing on page 1051, July MACHINERY, it is stated that the weld obtained by ordinary electric arc welding with carbon electrodes is so hard that it cannot be machined. This statement is erroneous. Carbon arc welding has been done in many steel foundries with a great degree of success, and, if the welding is properly done, little or no difficulty is encountered from the hardness of the weld.

* * *

Of the machine tools exported from Germany in 1920, 20 per cent went to Holland, 15 per cent to Switzerland, and 15 per cent to France.

The Metal-working Industries

THERE has been little change in conditions in the metal-working industries, but what has developed has been for the better. A greater demand for small tools, accessories, and grinding wheels is reported; the pig iron output shows an increase after nine months of steady decline—a rather certain and accurate indication of improving business in the metal-working field. The railroads are reporting decidedly better net earnings than in the past, and there is a tone of confidence in business in general that should not be overlooked. The credit situation has improved, and bankers, business men, and manufacturers alike agree that the lowest point of the depression has been passed and that improvements have taken place in many directions.

The Machine Tool and Small Tool Industry

In the machine tool field this improvement has as yet been but little felt, because there will be no appreciable buying of machine tools until the industries are working at greater capacity; but that many of the plants in the machine shop field have started to work is indicated by the demand for taps, reamers, milling cutters and drills, which has increased considerably during the past month. Some of the small tool plants are doing a business equivalent to from 25 to 35 per cent of capacity, and one shop reports doing a monthly business equal to the average monthly business for 1916. The manufacturers of grinding wheels report a similar condition—the demand having improved—and while orders are still small they are numerous. Business in hacksaws is reported to be quite satisfactory. In the machine tool field also, somewhat better conditions are reported by several dealers. The buying in general is done by small shops taking the cheaper types of machine tools. Sales of machinery for repair shops and garages have been unusually good, considering conditions. The second-hand market is quite active, particularly in the New England states. The foreign market for machine tools shows little or no improvement, although there has been a greater number of inquiries during recent weeks.

The most serious aspect of the situation is doubtless the large stocks on hand in the machine tool and the small tool fields. It will take considerable time to reduce these stocks to normal, and in many instances the stock manufactured from high-priced raw materials, and with labor at peak rates will have to be sold at considerable reductions, in some cases involving distinct losses.

According to the monthly review of the Federal Reserve Bank, the situation in the molding machine line, foundry supplies and hoisting machinery shows improvement, even though slight. The lowest point of the depression in these lines appears to have been passed.

Prices of Materials

Pig iron, being the basic raw material, represents, both as regards production and price, an index to the situation in the entire machine shop field. The price of pig iron seems now to have been stabilized at from $19 to $21 per ton, at base points, for different grades. A year ago these prices were from $46.50 to $50 a ton. The pre-war price was from $14 to $15 a ton. Steel billets previous to the war averaged about $25 a ton, and are now $29 a ton. Prices of structural steel and bar steel have been reduced in the past year and now compare with pre-war prices the same as pig iron and steel billets. But tool steel is still quoted at only 15 per cent below the peak price, and manufacturers of small tools are complaining about this, as it makes it impossible for them to reduce the prices of their products in proportion to the reductions taking place in other fields. The railroads also suffer from high prices of steel rails. Previous to the war the price was $28 per ton, but it is now $47, notwithstanding the fact that steel billets are only 16 per cent above the pre-war price. Lower rail prices aid the railways, and anything that aids the railways would aid, directly or indirectly, all the industries of the country.

The Automobile Industry

The production of the Ford factories broke all previous records during the month of August with a total output of 117,696 cars and trucks. The automobile industry continues to hold its own in spite of the prophecies to the contrary earlier in the year. The Studebakers production for August was also a record for that concern—8642 cars. The business of the Reo Co. for the same month has been surpassed only three times since the company's organization. All the automobile companies cannot report as favorable conditions, but on the whole the situation is much better than was expected during the earlier months of the year.

Reports from the automobile truck industry vary. One prominent manufacturer states that his orders for the month of July showed an increase over the corresponding month last year, which is the most encouraging report in this field since the beginning of the depression; but another manufacturer finds the truck business practically stagnant. Some of the 75,000 trucks which the Government sold last year in foreign countries were bought by speculators and have been returned to this country for marketing. This has increased the difficulties of both manufacturers and dealers.

The rubber industry has shown a steady improvement during the last few months, and many plants have almost reached capacity production. The industry in general is estimated to be running at approximately 80 per cent capacity, the peak having been reached about August 1, with a slight falling off since then.

The tractor and agricultural machinery business is still suffering from a severe depression, as farmers are repairing old rather than buying new equipment. The farm implement business is estimated at between 50 and 60 per cent of the business a year ago with large stocks on hand. Prices have not been materially reduced.

General Business Conditions

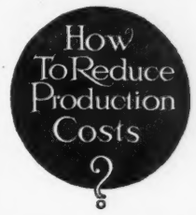
There are many indications of increasing industrial activity. The demand for coal is better, and there is an increase in the inquiries for iron and steel. Copper, after a serious decline in price, has advanced somewhat, and building materials are in greater demand. Bradstreet's reports are distinctly encouraging, showing an expansion of the jobbing trade and a great improvement in textiles, as compared with the earlier months of the year. The woolen industry, which in January was running at only 30 per cent capacity, averaged 80 to 90 per cent on July 1, with still further improvement reported since then. Some of the New England woolen mills are reporting day and night shifts. The improvement in the railroad situation is perhaps the most noteworthy. The deficit from which the roads suffered earlier in the year has been turned into a substantial surplus, so much so that the net revenue now almost equals the average for the three years ending June 30, 1917, which is considered the most prosperous period in American railroad history. This showing is all the more remarkable as the high freight rates have diverted much transcontinental traffic to the Panama Canal route.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

Lees-Bradner Gear-tooth Grinding Machine. Lees-Bradner Co., Cleveland, Ohio..... 147
Pawling & Harnischfeger Boring, Drilling, and Milling Machines. Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis..... 150
Pollard Work-bench. Pollard Bros., 4034-4036 N. Tripp Ave., Chicago, Ill. 151
Betts Car-wheel Boring Machine. Betts Machine Co., 400 Blossom Road, Rochester, N. Y..... 151
Graham Ring-wheel Grinding Machine. Graham Mfg. Co., 71 Willard Ave., Providence, R. I..... 152
Monarch Small-size Engine Lathes. Monarch Machine Tool Co., 209 Oak St., Sidney, Ohio.... 153
Van Dorn Heavy-duty Grinding Machine. Van Dorn Electric Tool Co., Cleveland, Ohio..... 153
"Cyma" Drawing Instruments. Edgar Bourquin, 1347 Main St., Waltham, Mass..... 154
Hansen "Electrocator." S. M. Hansen Co., 601 Washington St., Lynn, Mass..... 154
Ferracute Adjustable-bed Punching Press. Ferracute Machine Co., Bridgeton, N. J..... 154
Pratt & Whitney Bench Hand Milling Machine. Pratt & Whitney Co., Hartford, Conn..... 155
Janette Portable Buffing Machine. Janette Mfg. Co., 556 W. Monroe St., Chicago, Ill..... 155
Baker Drilling Machines. Baker Bros., Toledo, O. 155
Alcorn-Blockouse Heat-treating Furnace. Alcorn, Blockouse & Co., 1418 Walnut St., Philadelphia, Pa..... 156
South Bend Quick-change-gear Lathe. South Bend Lathe Works, 420 Madison St., South Bend, Ind..... 156
Rhodes Vertical Shaper Attachment. L. E. Rhodes, 51 Oak St., Hartford, Conn. 157
Pratt & Whitney Vertical Surface Grinding Machine. Pratt & Whitney Co., Hartford, Conn..... 157
Electro-Magnetic Portable Drill. Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill..... 158
Henry & Wright Bench Multiple-spindle Drilling Machine. Henry & Wright Mfg. Co., 760 Windsor St., Hartford, Conn. 158



Westinghouse Safety Motor-starting Switches. Westinghouse Electric & Mfg. Co., East Pittsburg, Pa..... 158
Meldrum-Gabrielson Adjustable Limit Snap Gages. Meldrum-Gabrielson Corporation, Syracuse, N. Y..... 159
Marquette Even-pressure Spring Cushion. Marquette Tool & Mfg. Co., 319-331 W. Ohio St., Chicago, Ill..... 159
Piston Grinding Attachment. Norton Co., Worcester, Mass. 160
Giles Trip-hammer Staking Machine. H. C. Giles Corporation, 303 Cox Bldg., Rochester, N. Y..... 160
Jackson Vertical-spindle Milling Machines. Jackson Machine Tool Co., Jackson, Mich..... 161
Pratt & Whitney Die-sinking Machines. Pratt & Whitney Co., Hartford, Conn..... 162
Bickford-Switzer Tap Grinder. Bickford-Switzer Co., 50 Norwood St., Greenfield, Mass..... 162
Oliver Vertical Hollow-chisel Mortiser. Oliver Machinery Co., Grand Rapids, Mich..... 163
Parker Self-tapping Screw. Parker Supply Co., Inc., 785 E. 135th St., New York City..... 163
Louisville Electric Grinding Machine. Louisville Electric Mfg. Co., Louisville, Ky..... 164
Young-Fischer "Inclinometer." Young-Fischer Inclinometer Co., Milwaukee, Wis..... 164
Ingersoll-Rand Belt-driven Air Compressors. Ingersoll-Rand Co., 11 Broadway, New York City 164
Utility Filing Attachment. Utility Tool & Mfg. Co., 2717 Lafayette Ave., St. Louis, Mo..... 165
Cincinnati Portable Drill. Cincinnati Electrical Tool Co., 1501-1505 Freeman Ave., Cincinnati, Ohio..... 165
Krag Spotting and Routing Attachment. E. L. Krag & Co., 50 W. Randolph St., Chicago, Ill..... 165
Bliss Press Attachment. E. W. Bliss Co., Brooklyn, N. Y... 166
Southwark-Gray Turret Rotary Shear. Southwark Foundry & Machine Co., Philadelphia, Pa..... 166
Blount Motor-driven Grinding Machines. J. G. Blount Co., Everett, Mass. 167
Universal Machine-aligning Level. Universal Boring Machine Co., Hudson, Mass..... 167

Lees-Bradner Gear-tooth Grinding Machine

For use in the production of hardened gears to insure accuracy of profile and spacing of teeth and an equal degree of precision as regards the concentricity of the bore with the pitch circle, the Lees-Bradner Co., Cleveland, Ohio, has developed a No. 10 gear-tooth grinding machine. In using this equipment, it is unnecessary to exercise special care in cutting the teeth or boring the hole. After the blank has been turned and bored and the teeth cut, the gears are hardened. Then the bore is rough- and finish-ground and the preliminary and final grinding operations are performed on the teeth. Owing to the fact that the bore is ground first, all grinding operations on the teeth are controlled from the bore and the teeth are thus ground true and concentric with the bore. Before entering into the details of the construction, attention is directed to Fig. 1 which shows the machine from the front, and to Fig. 2 which illustrates one end. The machine is adapted for grinding involute-tooth spur gears having pressure angles of from 14½ to 24 degrees, of any diametral pitch from 12 to 3, and of any pitch diameter from 2 to 12 inches. A 30-inch grinding wheel is employed, the wheel being mounted on a stationary column, and the work traversed past it by a slide having a reciprocating action. The work is given combined rotary and sliding motions in order to obtain the desired tooth profile as ground by the wheel

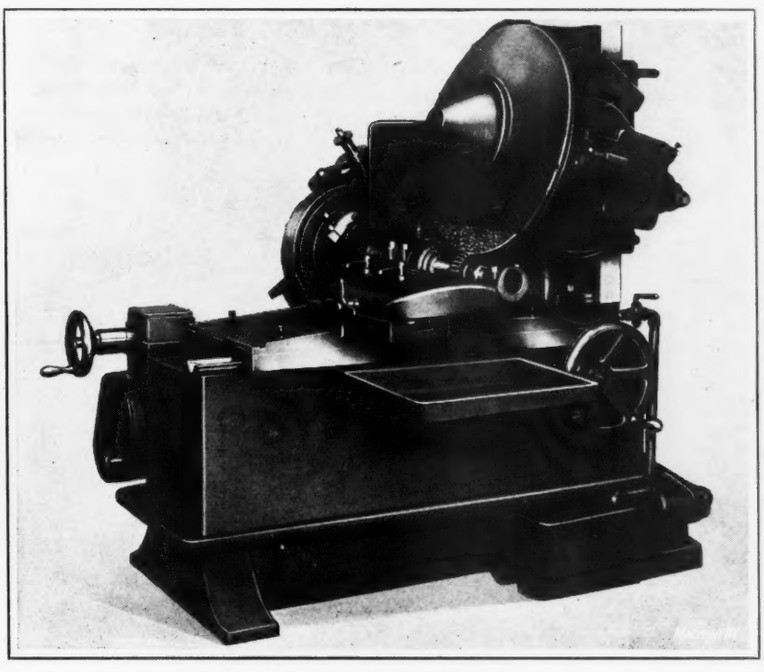


Fig. 1. Gear-tooth Grinding Machine developed by the Lees-Bradner Co.

face. A circular segment is used in conjunction with steel tapes or bands to obtain this combined sliding and rolling action. The segment can be modified in various ways to obtain any desired change in the tooth profile.

Truing and Driving the Grinding Wheel

A diamond which is lever and screw-controlled is used to true the face of the grinding wheel. The diamond is mounted in a ball socket container which can be swiveled to any angle, thereby permitting the diamond face to be used on all its edges. This container is locked into the arm, which is both power- and hand-controlled so that either a fast spiral cut or a slow continuous cut may be taken on the wheel face. The dresser is carried by the main swivel-head casting, which always locates the diamond point in one plane, and the adjustment is made endwise of the wheel when taking a dressing cut. The truing device is used in conjunction with the wheel-spindle micrometer feed.

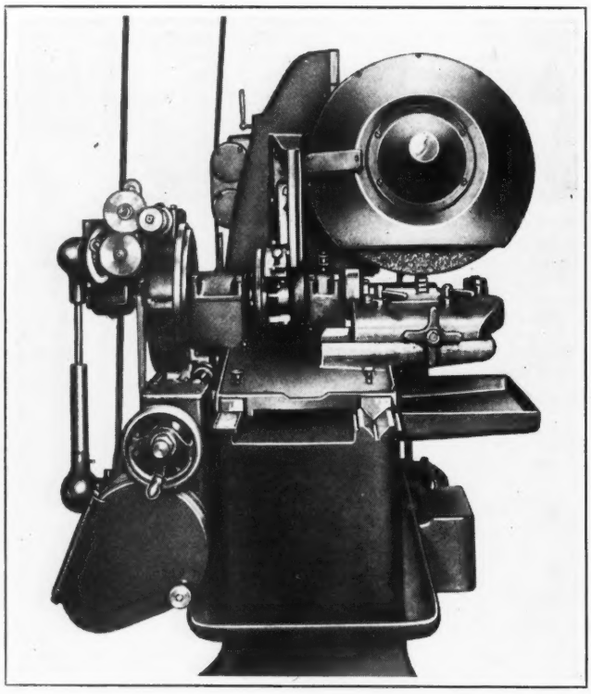


Fig. 2. End View of Gear-tooth Grinding Machine

An endless belt drives the wheel-spindle, this belt being guided by two idler pulleys at the rear of the machine and carried in a bracket having a sliding adjustment on the column to suit any diameter of gear being ground. The machine is driven by a single belt from a lineshaft, but a motor drive may be substituted when desired. Indexing of the work is accomplished by means of hardened and ground plates secured to the work-spindle and completely enclosed. These plates are made by the Warner & Swasey Co. who has a very accurate machine for work of this kind. The indexing is automatic and takes place at one end of the slide reciprocation. The wheel is set to the proper angle by means of a worm and segment on the swivel-head. A pump and connections supply coolant to the point of contact between the grinding wheel and the work. The latter can be held between centers or on a mandrel having a tapered shank to fit the work-spindle and supported at the outer end by the tailstock as shown in Fig. 3. In this illustration *D* indicates the mandrel, and *E* the work

Means of Obtaining Generating Motion

On this machine power is not applied directly to the work-slide, but to a sleeve in which the work-spindle rotates while indexing. When the machine is grinding, the sleeve and spindle rotate together as one unit. The sleeve carries the segment to which one end of each tape is fastened. The other end is secured to a bracket on the column; accordingly, when the sleeve is rotated first in one direction and then in the reverse direction, the tapes wind and unwind on the segment, and, through their pulling action on the bracket, cause the work-slide to reciprocate. This arrangement is shown in Fig. 4. A uniform torque load is transmitted to the work-spindle by a worm and worm-wheel, the primary function of which is to rotate the sleeve in the reverse directions. There is also a uniform load on the tapes, due to the fact that the frictional resistance of the work-slide on the ways is kept constant by gravity alone. The relation of the grinding wheel face to a gear tooth is illustrated in Fig. 5. The plane face of the grinding wheel has a continuity of action with the gear tooth being ground.

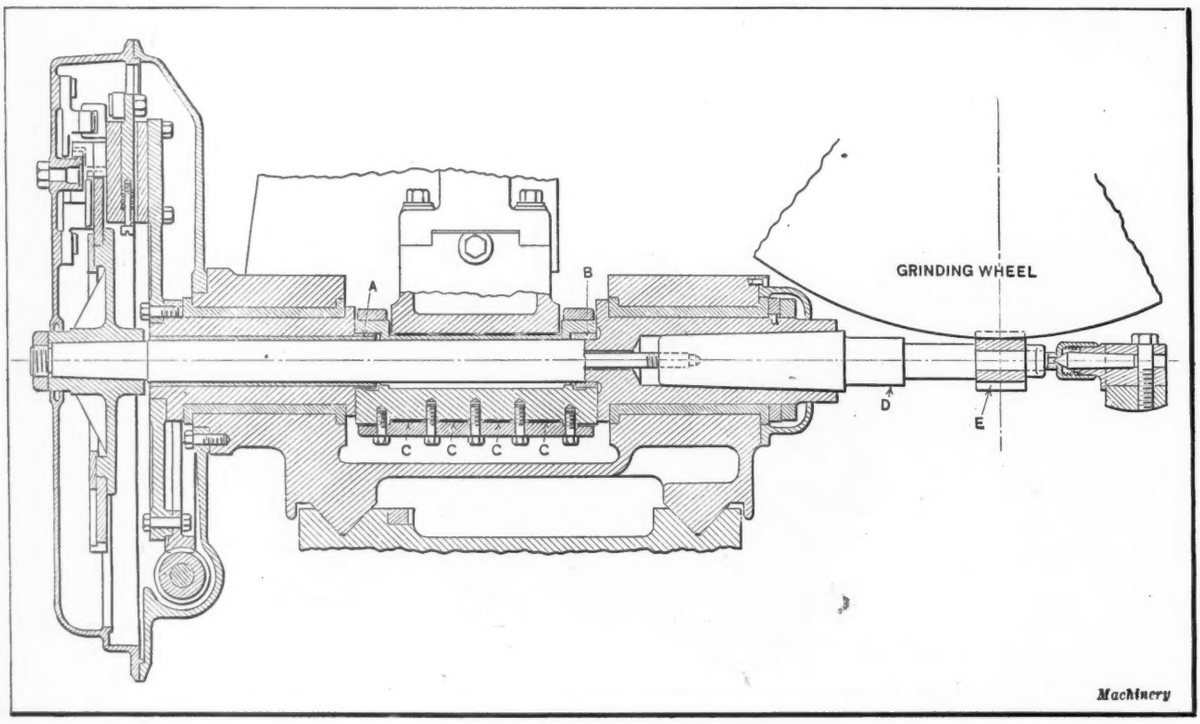


Fig. 3. Longitudinal Sectional View of Work-spindle

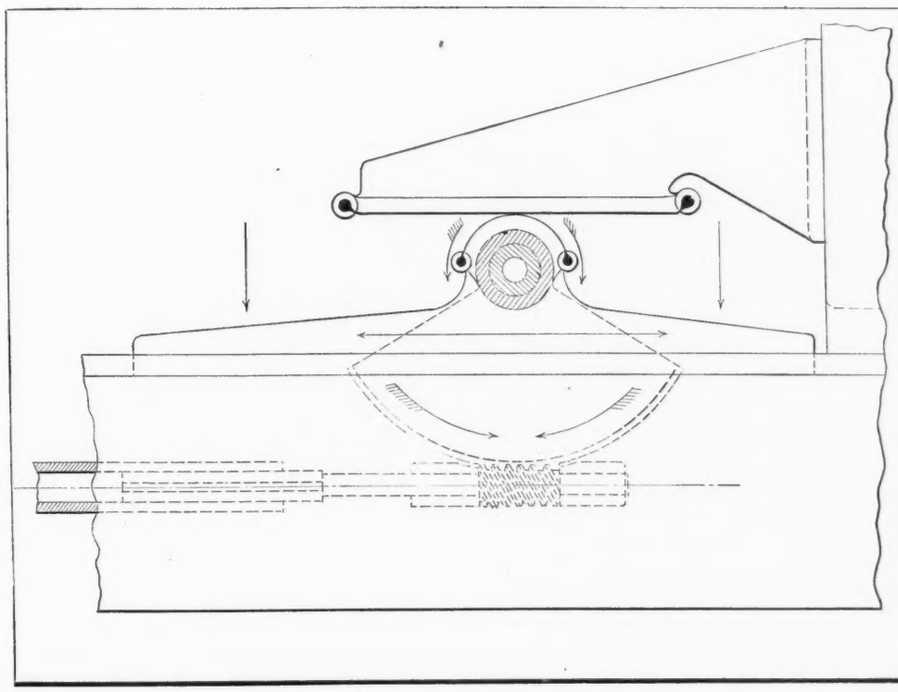


Fig. 4. Segment and Tape Principle of operating Work-slide

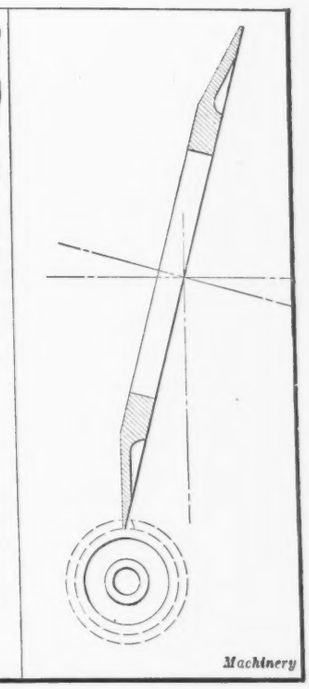


Fig. 5. Position of Wheel

How the Tapes and Segment are Mounted

The flat surface *A*, Fig. 3, of the grinding sleeve is utilized not only to drive the segment, but also to locate it in the correct relation to the spindle axis. There is also a support for the other end of the segment. This support is mounted so that it can rotate on the work-spindle, and has a flat locating surface *B*. Surfaces *A* and *B* are used as initial locating points for the radii of the segments, and should any modification of a radius be required, it is made by inserting or taking out metal shims at these points. The tapes are indicated by the letters *C*. They are all the same length and are placed in position loosely, both on the tape-bar and the segment. At the time of tightening up, an independent end adjustment of the tape-bar is used to move the tapes endwise, and in this way rotate the segment to its vertical position for the original set-up. A zero mark is placed on the bar and on the sleeve to facilitate obtaining this position.

The tight and loose pulley drive is so located that the driving belt can be used at any angle without interfering with the operation of the machine. The main shaft drives the gearing in a reverse feed-box in which speed-change gears are used to obtain the number of strokes per minute required of the work-slide. The length of the slide travel is regulated by a trip-dog located inside the gear-case. A starting and stopping lever controls the slide travel, and this is operated from the front of the machine. Hand adjustment of the slide is secured by means of a handwheel. A belt-shift lever is provided for the tight and loose pulleys, for starting and stopping the machine.

A section through the wheel-spindle is shown in Fig. 6, in which *F* indicates the spindle, and *G* the grinding wheel. Pulley *H* at the center of the spindle furnishes the drive. A micrometer adjustment is obtained by means of the worm and worm-wheel mechanism *J* which actuates a screw fastened to the sleeve in which the spindle is mounted. It will be seen that the spindle is mounted in ball and bronze bearings. End thrust of the spindle is taken by a raised shoulder *K* on the spindle, this shoulder being interposed between two ball bearings that are adjusted by cap-screws on the outer side of the flanged end cap. The taking up of the end thrust bearing at this point eliminates any displacement through heat acting on a long bearing and creating either play or tightness.

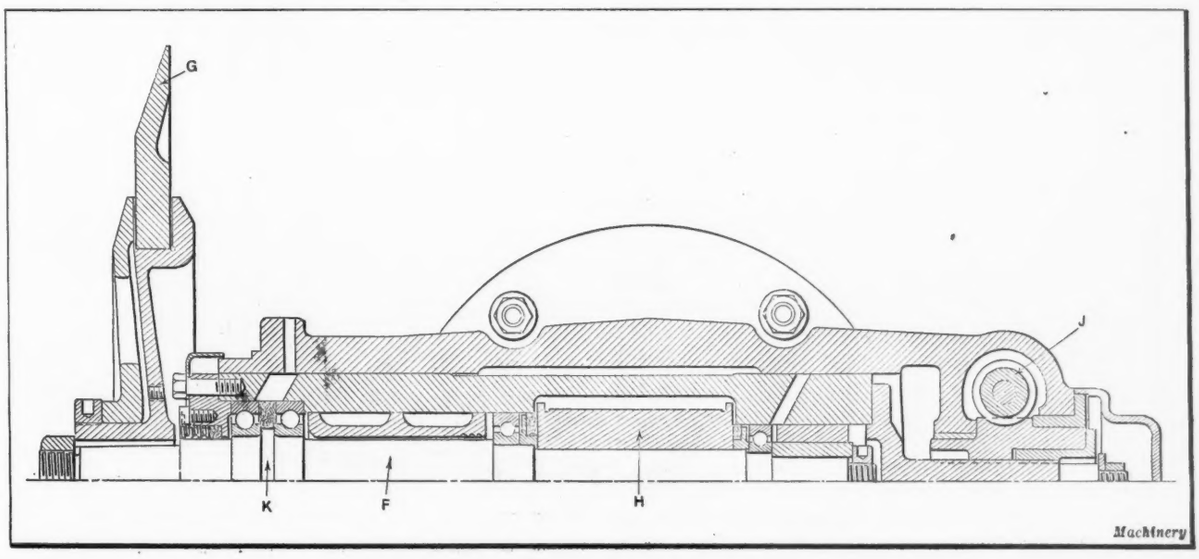


Fig. 6. Longitudinal Sectional View of Grinding Wheel Spindle

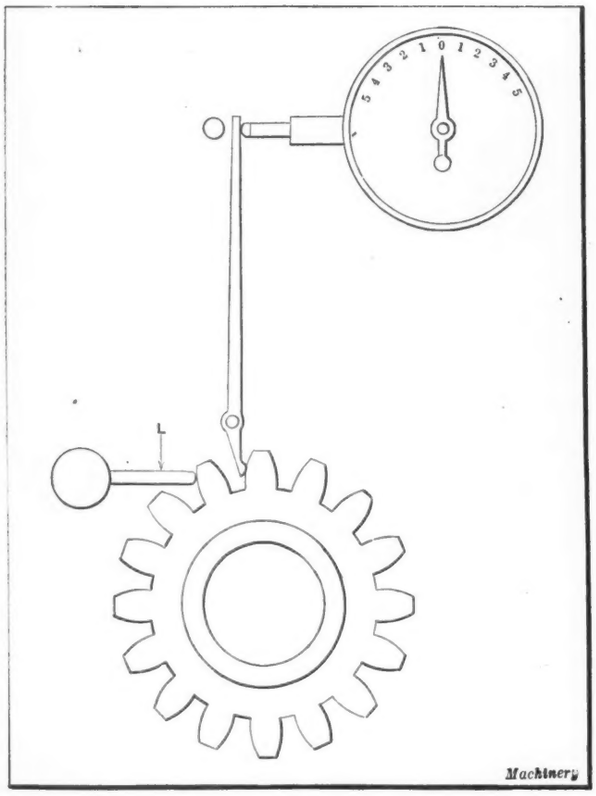


Fig. 7. Device used in testing Spacing of Gear Teeth

Operating the Machine

In operating the machine, the procedure is as follows: A segment corresponding to the pitch diameter of the gear to be ground is located on the work-spindle. The grinding wheel is set to the pressure angle of the tooth to be ground, and the wheel-head is raised to the proper height for the wheel to cover the working depth of the tooth. The wheel is then dressed. Two positive stop-pins located in a circular T-slot are used in conjunction with a positive stop to locate the wheel in the starting and finishing positions, and an intermediate spring stop is used in taking the roughing cut. The starting stop is usually set for the grinding of 0.004 inch from the gear teeth. The work is then locked on the arbor with a tooth in contact with the wheel. When the machine is started, the roughing cut is first taken, the grinding wheel being located by the spring stop to cut 0.003 inch from each tooth. Then the micrometer adjustment feeds 0.001 inch to the finishing stop, in this way removing the 0.004 inch allowed on the teeth for grinding. This movement brings the wheel back into the generating plane and into the position in which it was dressed. The wheel is generally redressed after the grinding of every two gears, and about 0.0004 inch is removed from its face. The dressing is accomplished by an independent feed to the micrometer, so that the starting and finishing stops need not be disturbed.

Modifying the Ground Tooth Form and Testing the Spacing of Gear Teeth

Thus far it has been assumed that perfect tooth profiles are required, but it is a matter of general knowledge that gears are not always used in machines having perfect alignment and accurate center distances, and which are free from other inaccuracies. Consequently the gears may need to be modified, or in other words, the profile changed to suit conditions. As previously explained, the modification of the profile is made by raising the segments by means of shims.

The method of measuring gear teeth for indexing is done by means of the device illustrated in Fig. 7 in which the gear is placed on a stud and a tooth turned against a positive stop *L*. The indicator is set to zero, after which the gear is indicated tooth by tooth, and if the reading remains at zero each time, the gear is perfect. Angular errors are recorded plus or minus by the indicator in increments of 0.0001 inch.

PAWLING & HARNISCHFEGER BORING, DRILLING AND MILLING MACHINES

A new line of horizontal boring, drilling and milling machines, of which the No. 4-F machine shown in Fig. 1 is the smallest size, has been developed by the Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis. These machines are especially designed for heavy milling and large boring operations, and can be used either as single-purpose machines or for general machine shop work. Among the features of the design are narrow guiding surfaces, take-up for all sliding parts, centralized control, and interchangeability of externally and internally driven faceplates. The back-gears are close to the spindle, and all driving shafts run at a high speed. Automatic stops are provided for the saddle and column of electrically driven machines. The column may be moved transversely on guides on the base by means of a screw. It may be traversed either forward or backward, by hand, power-feed or rapid traverse. The motor for driving the machine is located at the left-hand side of the column. The runway for the column is of a deep box section and is heavily ribbed.

The spindle saddle contains the drive for the spindle, the feeding mechanism, and the feed distributing mechanism. The main spindle sleeve bushing is made of phosphor-bronze, and is scraped to a slight taper so that wear of the sleeve may be readily compensated for. The saddle is guided on the column by a narrow guide located at the front. The feed-screw is located at the center of this guide. The saddle is counterbalanced by a weight inside the column, and is raised or lowered by a worm-wheel nut actuated by a screw. The raising or lowering of the saddle may be accomplished by hand, power-feed, or quick traverse.

The spindle is made from a high-carbon hammered alloy steel forging, and is ground to a sliding fit in the driving sleeve. Power is applied at the front end of the spindle while it is fed from the rear end through a rack and pinion.

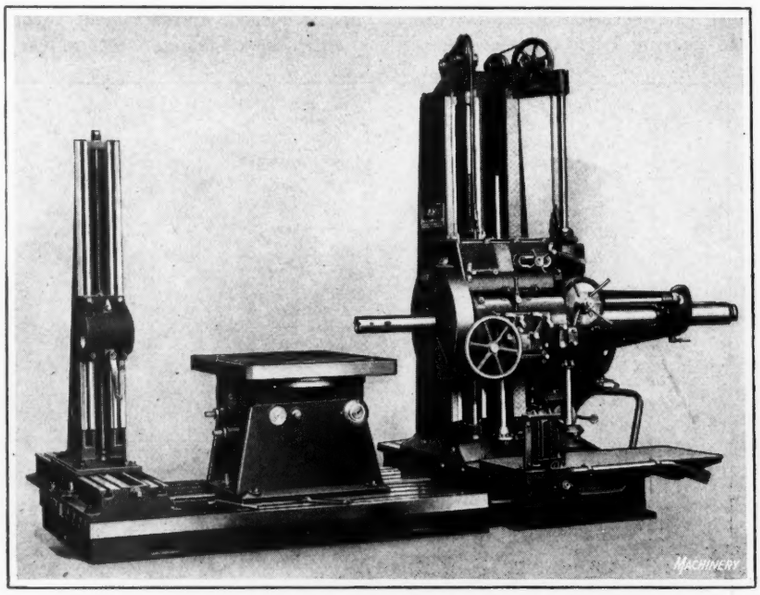


Fig. 1. Boring, Drilling, and Milling Machine built by the Pawling & Harnischfeger Co.

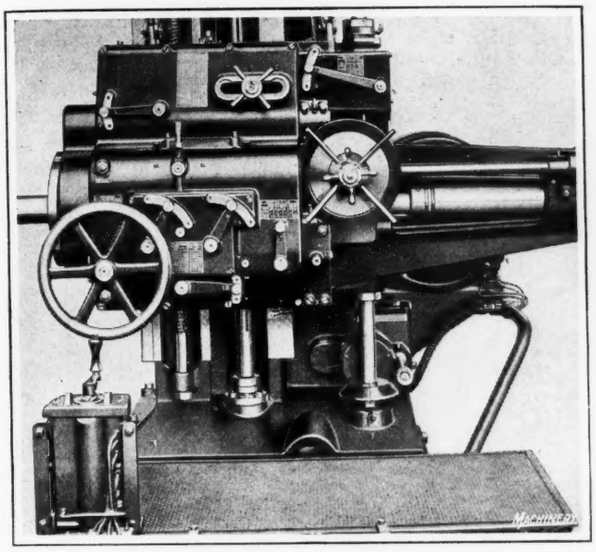


Fig. 2. Close-up View showing the Operating Levers arranged on the Saddle within a 42-inch Circle

The front end has a No. 6 Morse taper socket, and contains the necessary slots for driving milling cutters and boring-bars. The drive is transmitted to the spindle either through a small faceplate with a wide-face, coarse-pitch gear or a larger faceplate with an internal gear of coarse pitch and wide face. These faceplates have slots and tapped holes to provide for the attachment of milling cutters and facing heads. The feed of the spindle on this machine is 36 inches; the minimum height of the spindle from a 9-inch bedplate, 25½ inches; and the maximum height, 73½ inches.

The machine may be driven by a 10-horsepower constant- or variable-speed motor or by belt. The machine is double-back-geared and, through the operation of three levers, eighteen reversible spindle speeds in geometrical progression, ranging from 5½ to 200 revolutions per minute, can be secured. The boring and drilling feeds to the spindle are eight in number, reversible, and range from 0.0076 to 0.45 inch per revolution of the spindle. There are also eight reversible milling feeds to the column and the saddle, ranging from 0.009 to 0.54 inch per revolution of the spindle. The saddle and column have a rapid power traverse of 60 inches per minute.

All operating levers and handwheels are within easy reach of the operator and are conveniently arranged for the various operations. All levers are interlocking so that the engagement of two conflicting speeds or feeds at the same time is impossible. The work bed is provided with planed T-slots running parallel to the direction in which the spindle traverses. A planed squaring strip for aligning work is provided on three sides of the bed. The latter can be made to any desired size. The outer support, unless otherwise specified, has vertical and transverse movements of 48 inches. Graduated verniers reading to 0.001 inch are furnished for the main column and saddle and the outer support and saddle. A screw chasing attachment for cutting threads varying from 2 to 16 per inch and to any length within the capacity of the machine, can be furnished. A universal tilting and revolving table or a plain revolving table with movement by hand or power can also be furnished. The No. 4-F machine without bedplate, outer support, tables or electrical equipment, weighs about 17,000 pounds.

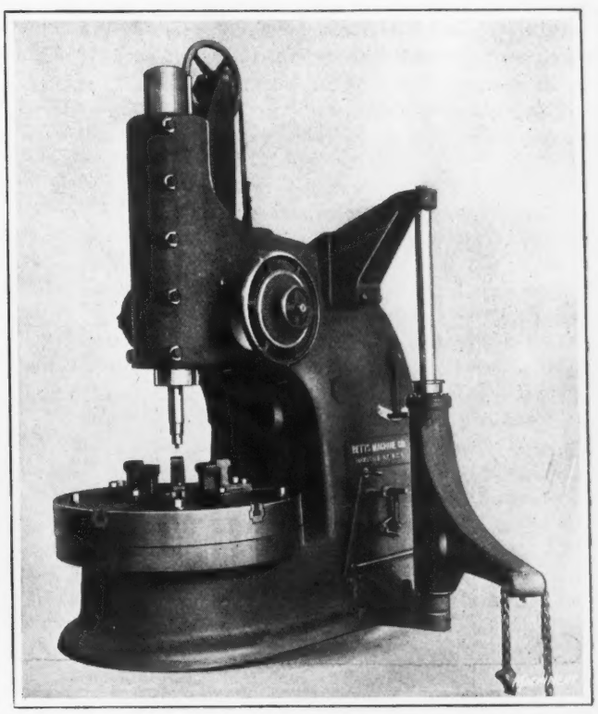
POLLARD WORK-BENCH

A small work-bench designed for use in garages and by mechanics at home is now being placed on the market by Pollard Bros., 4034-4036 N. Tripp Ave., Chicago, Ill. The top is made of selected heavy Norway pine. The legs are constructed of 1¼-inch angle-irons, each pair of legs being joined by three cross-braces welded together. The legs are punched for fastening to the floor. Two 3-inch flat steel bars bolted to the legs act as stringers, and eliminate any side or end sway. A large drawer, independent of the top and sliding on angle cross-braces welded to the legs, is furnished. A semi-steel machinist's vise with 3-inch tool-steel jaws having a 4-inch opening, is mounted on the bench. The bench top is 33 inches above the floor, 44 inches long, and 16 inches wide. The drawer is 23½ inches wide, 15½ inches from front to back, and 5 inches deep. A recess at the rear of the top will hold tools, nuts, bolts, etc. The weight of the bench complete, equipped with a vise, is 65 pounds. The wooden portions are shellacked, and all metal parts are painted black.

BETTS CAR-WHEEL BORING MACHINE

A 52-inch car-wheel boring and facing machine has been added to the line of heavy railway machines manufactured by the Betts Machine Co., 400 Blossom Road, Rochester, N. Y. This machine is intended to cover the requirements of both manufacturing and repair shops. The bed and frame are one massive casting, and the entire machine is designed to withstand high stresses. Special attention has been given to simplicity of operation. The machine may be driven by a single pulley or by being direct-connected to a constant- or variable-speed motor. The necessary speed changes to given faceplate revolutions of 10.2, 13.9, 20.4 and 30.7 per minute are obtained by means of hardened sliding steel gears running in oil. The two short levers seen on the frame in the accompanying illustration are used for obtaining the four speed changes. These levers are interlocked so that no two sets of gears can be placed in mesh at the same time.

The table revolves on a wide bearing and has a large spindle running in a bronze-bushed bearing. This spindle is provided with a locking collar at the lower end to prevent it from lifting. The table is equipped with a five-jaw chuck that is both universal and independent, and is readily adjustable for wheels of any size within the range of the machine. Five stations are provided for operating this chuck so that one of them will be convenient to the operator, regardless of where the table is stopped. The long lever seen



Railway Car-wheel Boring Machine built by the Betts Machine Co.

just to the right of the table is used for operating a friction clutch and brake, whereby the machine may be started and stopped instantly.

Six automatic boring and facing feeds are obtained by means of a two-step cone pulley and sliding steel gears so arranged that the feeds can be changed instantly from roughing to finishing. The boring ram has an easy hand adjustment that is facilitated by a counterweight within the machine. When so desired, the machine can be equipped with a facing ram on which the facing head is supported close to the cut. This ram is of such construction that it can be slid out of the way when chucking wheels of large diameter. The machine is regularly equipped with a quick-acting air-operated crane for loading and unloading the car-wheels. This crane can also be arranged to be driven by an individual motor or by belt. All control levers and the hand adjustment of the boring ram are within easy reach of the operator from one position.

Fig. 1. Knee-type Ring-wheel Grinding Machine brought out by the Graham Mfg. Co.

GRAHAM RING-WHEEL GRINDING MACHINE

The knee-type ring-wheel grinding machine illustrated in Fig. 1 was recently developed by the Graham Mfg. Co., 71 Willard Ave., Providence, R. I. The abrasive wheel has an outside diameter of 12 inches and a hole 7 inches in diameter, so that the face is 2½ inches wide. The thickness of the wheel when new is 3 inches, and it can be worn to a thickness of about ½ inch. The wheel is held in place by a pressed-steel holder, manufactured by the same concern, which was described in May, 1909, MACHINERY. The construction of this holder can be seen by reference to Fig. 2, which shows a sectional view of the wheel-head. The ring-wheel is clamped in this holder by means of a cone-shaped ring that is drawn into an internal tapered surface in the body. An adjustable flange which screws on the hub of the holder is employed to advance the wheel as the latter becomes worn, and it is an easy matter to remove a worn ring.

After the wheel is in place it can be easily trued up and the cutting face reduced to any desired width. A holder for commercial truing devices is supplied, which is fastened to the table. The machine may be driven by a belt from a countershaft as provided for on the machine illustrated, or it may be driven by a motor, mounted on a bracket at the back of the machine and attached to the rear end of the wheel-spindle by means of a flexible coupling. The machine may also be driven by belt from a motor mounted on a bracket on the right-hand side of the column, or one placed inside the column and belted upward. A fifth driving method is by means of a motor built into the head.

The column has cast ledges on the inside to provide for shelves; however, the space may be used for a starting box. Water is supplied to the work by means of a No. 2 B. & S. centrifugal pump, fastened to a tank at the rear of the machine, the water being applied to the work through a nozzle fastened to universal pipe joints. The head is cast separately and is provided with bushings for holding the outer races of the Timken roller bearings with which the spindle is equipped. In order to reduce end play to a minimum, the rear bushing is a close sliding fit in the head and is pushed, by means of a coil spring, in the proper direction to automatically take up all end motion and wear. Further adjustment is attained by means of a castellated nut and cotter-pin. The spindle is made of tool steel and is provided at the front end with a collar shrunk on and machined to

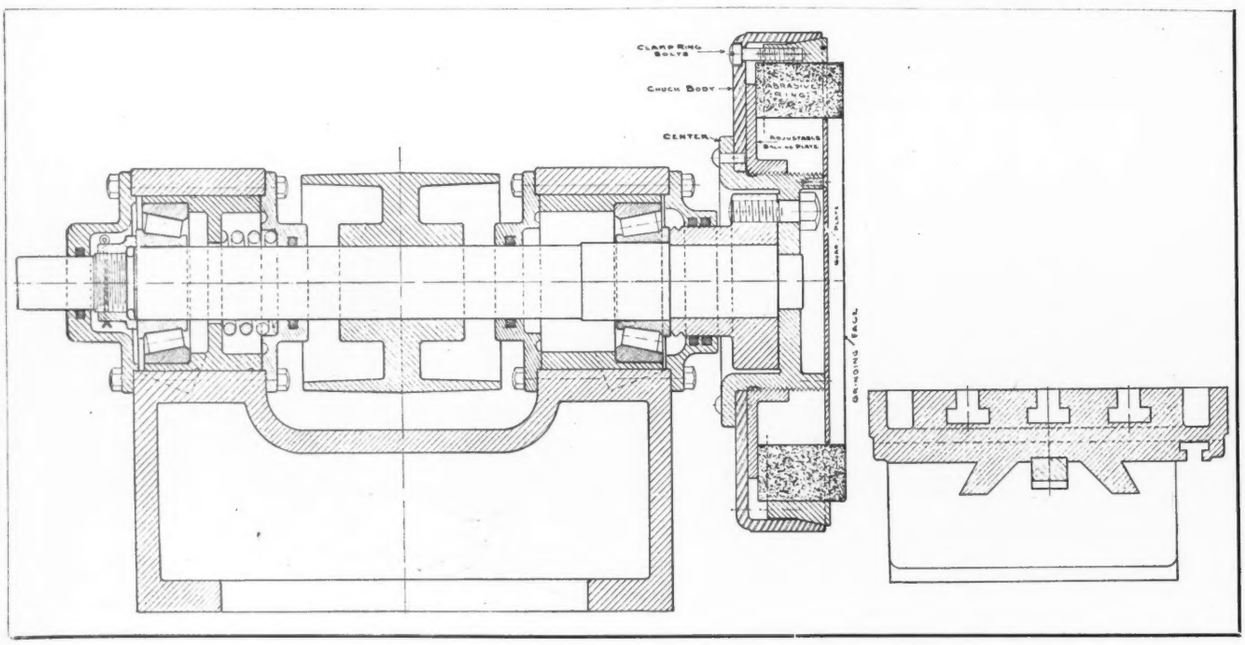


Fig. 2. Sectional View through Wheel-head of Ring-wheel Grinding Machine

accommodate the ring-wheel holder. Felt-packed dust collars protect all running parts on the head, and glass oilers indicate the amount of lubricant in the bearings.

The knee is of box construction, and is adjusted by an elevating handwheel set at an angle. A water trough is machined and fitted to the knee. The table block rests on the knee and is gibbed. It is fitted with an adjustable nut for the cross-feed shaft. This nut may be indexed in increments of 0.001 inch and serves to regulate the depth of cut. The table is fed past the wheel by means of a pinion and rack operated by the spider wheel at the right end. The top surface of the table has standard T-slots in it. Sufficient water guards are furnished to prevent the operator from becoming splashed. These guards were removed at the time the photograph reproduced in Fig. 1 was taken, in order that the construction of the machine could be more readily observed. Some of the specifications of this grinding machine are as follows: Height from floor to center of spindle, 42 inches; working surface of table, 24 by 10 inches; maximum travel of table, 16 inches; vertical movement of table, 7 inches; speed of machine, when driven by standard motor, 1780 revolutions per minute; and weight of machine, approximately 2000 pounds.

MONARCH SMALL-SIZE ENGINE LATHES

A line of engine lathes of 9- and 11-inch swing, made in bed lengths of from 2½ to 5 feet, has been brought out by the Monarch Machine Tool Co., 209 Oak St., Sidney, Ohio. These machines are sold under the trade name of "Monarch Junior." A 9-inch lathe provided with bench legs is shown in Fig. 1, while Fig. 2 illustrates an 11-inch machine equipped with a chip pan and floor legs. The headstock of these machines is of the solid full-webbed bowl type, and the spindle is made from crucible steel, accurately ground and having a 1 1/16-inch hole running through its entire length. The spindle is driven through a three-step cone pulley and single back-gears. The latter are locked in and out of position by a ball and spring plunger.

The base of the tailstock is graduated to enable accurate settings for taper-turning, and is so arranged that it can be considerably overhung on the bed to give greater distances between centers. Either a full-quick or semi-quick change-gear box can be furnished. With the former, fifty-four changes of threads and feeds are obtainable. The feed and lead-screw reverses are secured through a lever on the headstock. Reversing is done instantly, while the lathe is running. The countershaft is equipped with Edgemont friction clutches and cast-iron hangers provided with ring-oiled bearings.

The compound rest is gibbed throughout, and has large bearing surfaces. The toolpost is provided with a "Mac-It" non-breakable screw. The lead-screw is tested on a Hartness screw-thread comparator. The carriage is drilled and tapped to receive a taper attachment, chasing dial, or chasing stop. The upper knurled handwheel on the apron has three positions; when thrown to the left-hand position, the longitudinal feed is engaged, when placed in the right-hand position, the cross-feed is engaged, and when placed in the neutral position, the half-nut is engaged. The lower knurled handwheel controls the mechanism that operates both the power cross-feed and the longitudinal feed. The regular equipment furnished includes a double-friction countershaft, faceplate, dog plate, center-rest, follow-rest, centers, compound rest, and wrenches. A taper attachment, draw-in attachment, and other accessories can be applied by a customer without any machine work or fitting.

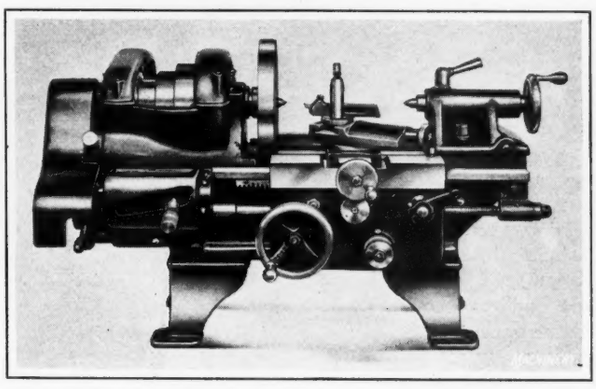


Fig. 1. Small Engine Lathe built by the Monarch Machine Tool Co.

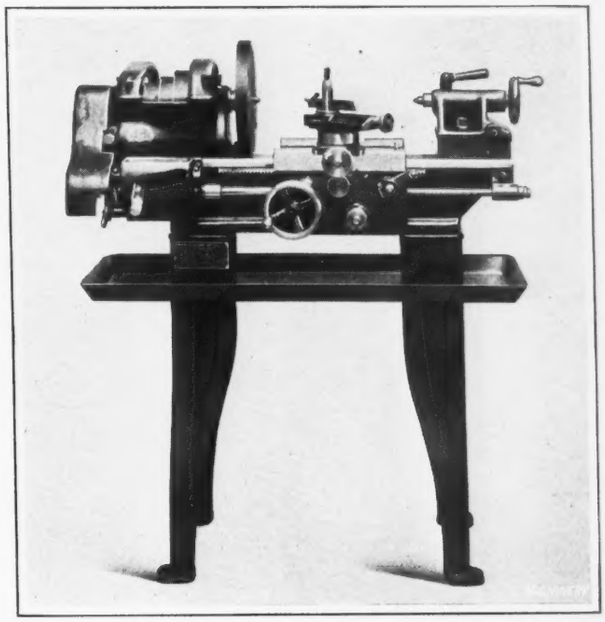


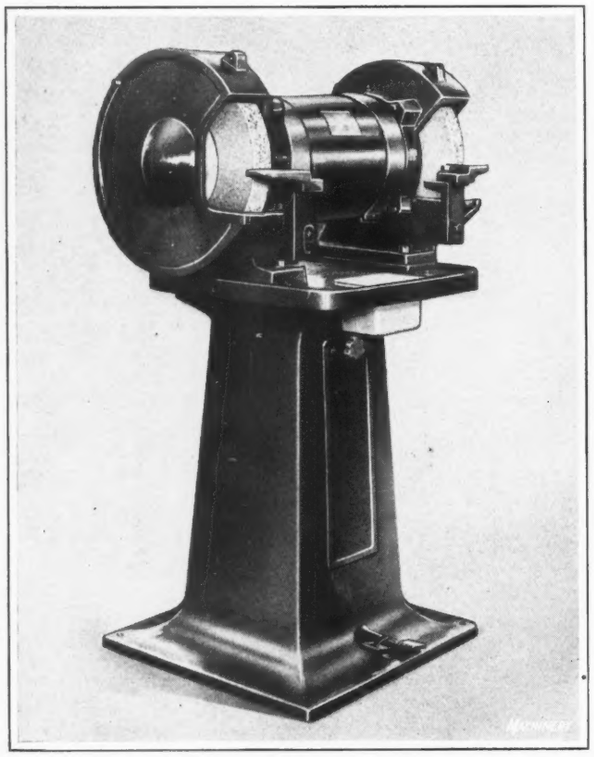
Fig. 2. "Monarch Junior" Lathe provided with Floor Legs and Chip Pan

VAN DORN HEAVY-DUTY GRINDING MACHINE

The heavy-duty ball-bearing grinding machine here illustrated has just been introduced to the trade by the Van Dorn Electric Tool Co., Cleveland, Ohio. It is equipped with two grinding wheels, 14 inches in diameter, and 2½ inches face width. These wheels are mounted directly on the ends of a 1¼-inch motor shaft, and they are quickly changed by removing four bolts and the end flanges. Provision is made on the wheel guards for connection with exhaust ducts when desired, and a lug on each guard permits an eye-shield to be attached. The tool-rest can be conveniently located by horizontal and vertical adjustments. An aluminum water pot is located in the proper position to be reached by a short movement of the arm. This pot may be readily lifted out of place.

The motor was designed especially for this machine, and its rating is 4 horsepower for normal continuous operation, and 7 horsepower for a momentary overload. The standard motors operate on three-phase, 60-cycle alternating current with either 220 or 440 volts, but special windings such as two-phase 60-cycles, or three-phase 50-cycles, with either of the given voltages, are made to special order. The speed of the 60-cycle motors is 1200 revolutions per minute, and that of the 50-cycle motor, 1500 revolutions per minute. The motor is completely enclosed by a dustproof housing which is smaller in diameter than the grinding wheels, so that there is ample space for the operator's hands to move without coming in contact with the machine. Interference when grinding long pieces is also obviated.

Ventilation under all normal conditions is furnished by a fan within the motor, but under conditions of excessive dust a supply of fresh air may be piped to the intake of the housing. The motor shaft is set in large ball bearings rigidly

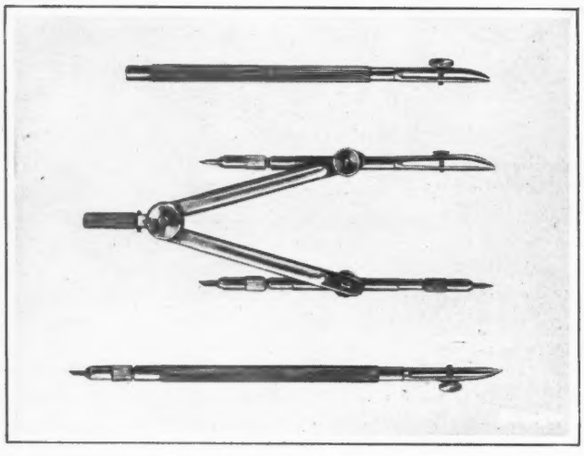


Heavy-duty Ball-bearing Grinding Machine built by the Van Dorn Electric Tool Co.

supported by the housing. Lubrication is accomplished by inserting a grease-gun nozzle in grease ports located directly above the bearings. The pedestal serves as a cabinet for the switch, fuses and connections. The cable conduit enters through a hole at the back, and no wires or electrical appliances are exposed anywhere on the machine. The machine is started and stopped by a pedal switch located at the base of the pedestal. The spindle center is 39 inches above the floor, and the grinding wheels are set 25 inches apart. The machine weighs approximately 700 pounds.

"CYMA" DRAWING INSTRUMENTS

The drawing instruments illustrated are being sold by Edgar Bourquin, 1347 Main St., Waltham, Mass., under the trade name of "Cyma." The ruling pen at the top of the illustration is of the standard type, while that at the bottom is provided with a lead end. The instrument at the center is a combination divider and pen and lead compasses. Either the pen, lead, or divider points may be brought into position for use by swinging the lower legs of the instrument which are pivoted at the center. The legs are clamped in position by tightening a nut at the fulcrum. The divider points may be used for scribing on metal. This combination compass and divider is intended for use as a pocket instrument by draftsmen, machinists, patternmakers, etc.

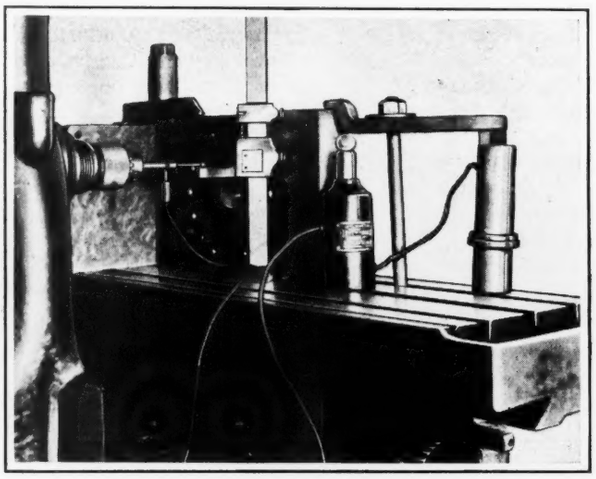


"Cyma" Drawing Instruments

HANSEN "ELECTROCATOR"

An instrument known as the "Electrocator," intended for use in ascertaining the alignment of machine members and in the locating of surfaces or centers for the accurate machining of parts, has been developed by the S. M. Hansen Co., 601 Washington St., Lynn, Mass. The Bely Sales Co. of the same address is the sales agent. When this instrument is used, the previous lay-out of centers is unnecessary, and the use of plugs and buttons is entirely dispensed with. The illustration shows the "Electrocator" being used for locating the center of a hole to be machined in a part mounted on the table of a milling machine.

The ball pointer is held in a chuck inserted in the spindle of the machine, and a vernier height gage is set to the distance that the center of the hole is to be located above the table, allowance, of course, being made for one-half the diameter of the ball end on the pointer. This pointer is connected to an electric light on the member of the instrument shown on the table, which, in turn, is connected to a light socket. When the gaging surface of the vernier gage is



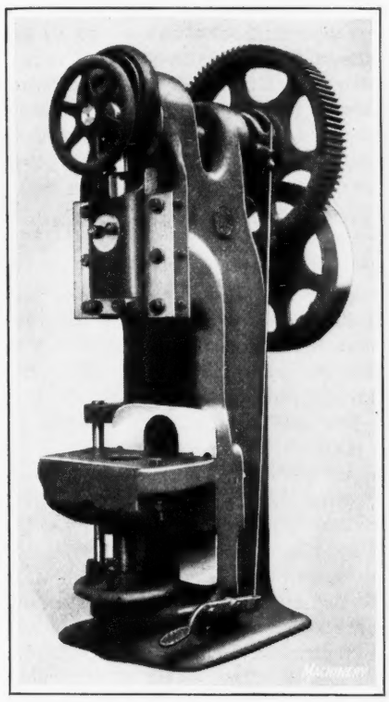
"Electrocator" made by the S. M. Hansen Co., being used on a Milling Machine

constantly in contact with the ball point as the spindle revolves, the light remains lit.

The concentricity of round pieces can be readily determined, as the light will go on and off according to the amount that a piece is out of round. The instrument may also be used for testing the alignment of the tables and knees of machine tools and the alignment of a lathe bed with its spindle. The ball pointer can be held in a chuck or clamped to the side of an arbor or boring-bar.

FERRACUTE ADJUSTABLE-BED PUNCHING PRESS

A punching press designed for work requiring a long stroke and an unusual height between the bed and the ram is shown in the accompanying illustration. This machine is built by the Ferracute Machine Co., Bridgeton, N. J., and is equipped with a bed that is adjustable vertically. As the bed and frame are separate castings, it is essential that their connection be strong and rigid, and this condition is obtained by attaching the bed to the frame by heavy steel bolts, and supporting the bed on a steel adjusting screw 4 inches in diameter.

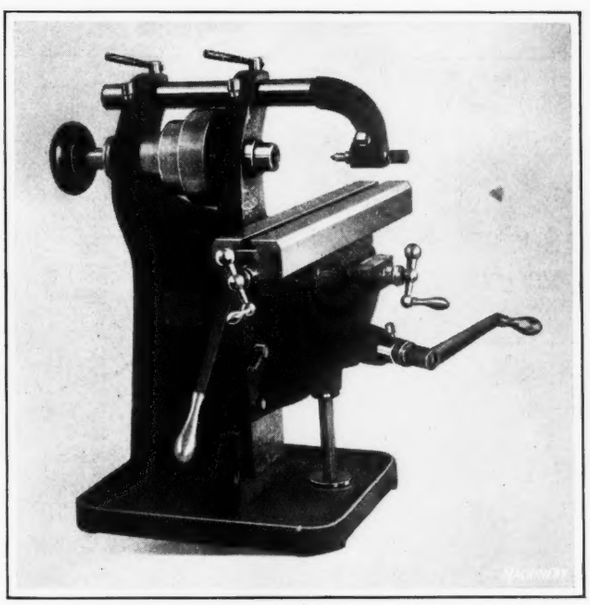


Adjustable-bed Punching Press built by the Ferracute Machine Co.

A projection at the back of the bed fits a planed vertical guide in the frame, and keeps the top of the bed parallel with the bottom surface of the ram at all times. The press may also be used for horning operations by inserting a horn in a 9½-inch hole in the frame. The bed is hinged on a vertical rod at the left-hand side of the machine which enables it to be swung out of the way when the machine is used for horning. The ram has a maximum adjustment of 3 inches, and the bed 9 inches. The distance between the bed and the ram, when the former is adjusted to its lower position and the ram is at the top of its stroke and its highest adjustment, is 30 inches. The ram stroke is 8 inches. The press exerts a pressure of 70 tons, and weighs approximately 13,200 pounds.

PRATT & WHITNEY BENCH HAND MILLING MACHINE

An addition to the line of machine tools built by the Pratt & Whitney Co., Hartford, Conn., is the No. 3 bench hand milling machine here illustrated. The spindle and draw-back on this machine is identical to that provided on the No. 3 bench lathe manufactured by the same concern, and therefore all the spindle attachments of the bench lathe interchange on the milling machine. The table of the latter is of a design suitable for the mounting of attachments and it accommodates the headstock and tailstock of the bench lathe. All screws on the machine are equipped with micrometer dials graduated to 0.001 inch.

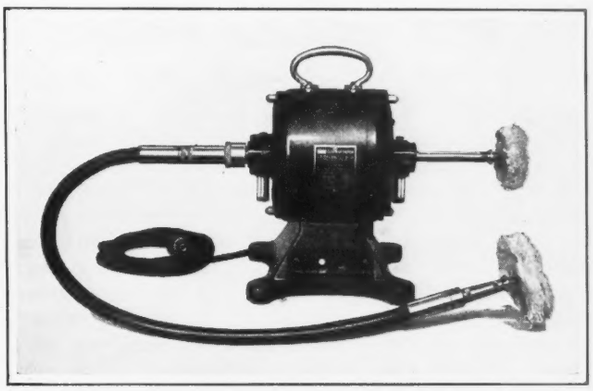


No. 3 Bench Hand Milling Machine manufactured by the Pratt & Whitney Co.

The spindle is made of tool steel, is hardened and ground, and has a conical front end. The front spindle bearing has a double taper, and is also made of tool steel and hardened and ground. A "Non-Gran" bronze bearing is provided at the rear of the spindle. Both bearings are adjustable for wear. The spindle is driven through a three-step cone pulley, which provides speeds ranging from 153 to 1510 revolutions per minute. The special equipment which can be furnished for this machine includes a swivel vise graduated in degrees, an index quill center, a tailstock, arbors for saws, a right-angle adapter, and a vertical milling attachment. The latter is mounted over the spindle nose and is driven by a plug placed in a draw-in collet.

JANETTE PORTABLE BUFFING MACHINE

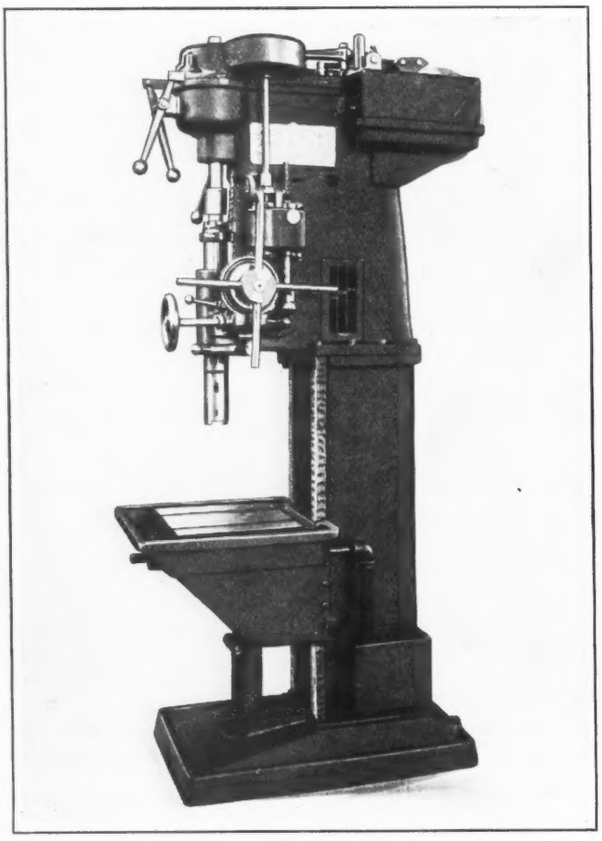
For use in the performance of buffing operations in cases where it is most convenient to take the machine to the work, the Janette Mfg. Co., 556 W. Monroe St., Chicago, Ill., has developed the portable equipment shown in the accompanying illustration. It will be seen that this machine is furnished with two wheels. One of these is mounted at the end of an extension of the armature spindle, and the other is driven by a flexible shaft. This combination assures maximum convenience in handling a wide range of work. The motor is furnished with a 10-foot connection and plug to screw into a lamp socket. The motor develops ¼ horsepower at 3500 revolutions per minute, has a push-button control, and may be supplied for alternating or direct current. With suitable modifications this machine could be adapted for other operations besides buffing.



Two-wheel Portable Buffing Machine introduced by the Janette Mfg. Co.

BAKER DRILLING MACHINES

Baker Bros., Toledo, Ohio, have added the No. 121 single-purpose and the No. 121 quick-change drilling machines to their line of products. These machines are adapted for driving drills ranging from ⅜ to 1½ inches in diameter, and in the general lines of construction are somewhat similar to the No. 217 single-purpose and the No. 314 flexible machines manufactured by the same concern. There are, however, a number of changes and improvements of design, the more important of which will be mentioned in the subsequent description. The No. 121 quick-change machine is shown in the accompanying illustration. The single-purpose machine is similar to this, but the feed-box is provided minus the feed-change gears, shafts, etc. A single-purpose machine can be converted into a quick-change type by the provision of the necessary shafts and gears, which are interchangeable so that they can be assembled without fitting.



No. 121 Quick-change Drilling Machine built by Baker Bros.

Slip change-gears are furnished in addition to the sliding gears to increase the range of speeds, so as to assure the efficient operation of all sizes of drills. This provision also facilitates the efficient use of different sizes of taps. It will be seen that a cabinet is provided in the column to receive these slip change-gears. The introduction of slip change-gears also provides different feeds from those formerly supplied, and so a different dial is provided to correspond with each set of slip change-gears. Attention is called to the convenient arrangement of all operating levers, which are not only centralized, but also located to enable the hands of the operator to move continuously from the highest position downward in shifting levers manipulated with either his right or left hand.

Another feature of the improved design is the casting of the bearing brackets for the tight and loose pulleys integral with the machine column, the pulleys being located directly behind the column. This arrangement is important when it is desired to set machines in gangs, as it brings the control levers on all machines within easy reach of the operator and saves floor space. Simultaneously with the throwing of the belt on the loose pulley, a cam-actuated brake is applied to the tight pulley to bring the machine to a stop quickly. A piston on the spindle rises into a cylinder as the counterbalanced spindle rises rapidly to the starting point after the feed has been tripped. By this means the spindle is quickly returned without occasioning any shock as it reaches the top of its upward movement.

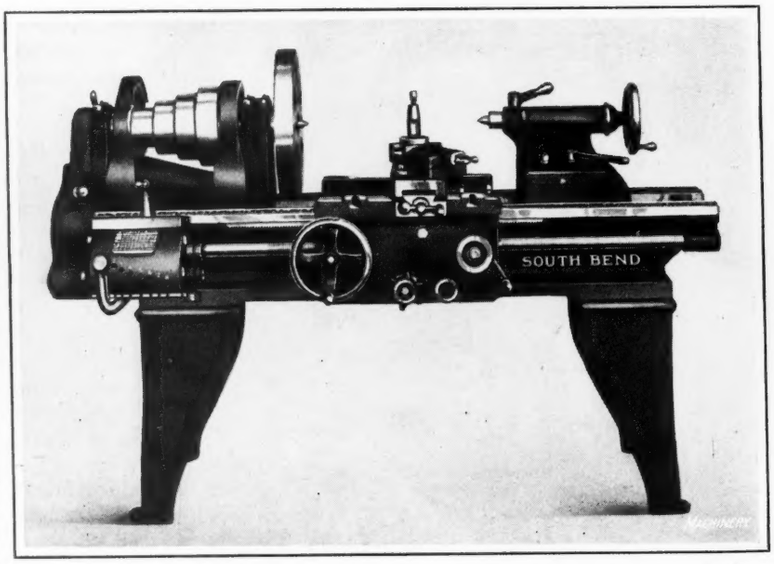
Included in the table-elevating mechanism is a sleeve nut that slides in an auxiliary column. In adjusting the position of the table, the bolt which clamps this sleeve is loosened; then by clamping the table to the main column of the machine and turning the table-elevating crank, the sleeve may be raised or lowered. By tightening the sleeve-clamping bolts and loosening the table-clamping screws, the table is ready to be moved to any desired height. Attention is finally called to the fact that the speed change-gear box is made as a unit which may be readily removed from the column. Ball and roller bearings are provided for the shafts in the speed-box.

ALCORN-BLOCKOUSE HEAT-TREATING FURNACE

An automatic continuous heat-treating furnace of a conveyor type, which is equipped with a combination conveyor for such articles as crankshafts, camshafts, and rear axle shafts, and for miscellaneous small pieces, such as gears, has been produced by Alcorn, Blockouse & Co., 1418 Walnut St., Philadelphia, Pa. The motion of the conveyor is always vertical, so that there is no longitudinal motion in the furnace. The important advantages are a uniform heating of the pieces being treated and the elimination of skilled labor. An increase in fuel efficiency and a decrease in repair and upkeep costs are also claimed. The uniformity of treatment and the reduction in fuel costs are due to the fact that the pieces are suspended above the furnace hearth and, except with flat pieces, are continuously revolved or turned over during the entire treatment. This eliminates spots due to contact with the hearth. The length of treatment is automatically controlled by a variable-speed motor, and the temperature is controlled by Leeds & Northrup control instruments having a temperature recorder. The furnace can be heated by electricity, gas, oil, coal, or any other kind of fuel which will produce the necessary heat.

SOUTH BEND QUICK-CHANGE-GEAR LATHE

The quick-change-gear lathe shown in the accompanying illustration has recently been added to the line of lathes manufactured by the South Bend Lathe Works, 420 Madison St., South Bend, Ind. It is made in eight sizes ranging from 9 to 24 inches swing, and may be provided with either a straight or gap bed. The quick-change gear-box is the same as that provided on Flather lathes, and has forty-eight changes of feeds and threads. These changes are also available for the cross-feed. All gears in the gear-box are made of steel forgings. The index-plate shows the holes in which to insert the plunger for the different changes, and the crank-lever above the box operates an inside clutch.



Quick-change-gear Lathe built by the South Bend Lathe Works

The bed has three vees and one flat way for guiding the headstock, tailstock, and carriage. The headstock is equipped with an improved reverse and a hollow spindle made of special steel and accurately ground. The tailstock is offset to allow the compound rest to be swiveled parallel to the bed, and is provided with a set-over to enable the turning of tapered parts. The tailstock center is self-ejecting. The carriage is provided with T-slots for clamping work to be milled or bored. Both the automatic cross-feed and the automatic longitudinal feed of the carriage are operated from the front of the apron, and but one feed can be engaged at a time. Both feeds are driven by a splined screw and worm so that it is only necessary to use the lead-screw thread when thread cutting.

The compound rest is graduated to 180 degrees, and the cross-feed screw has a micrometer graduated collar reading to 0.001 inch. The regular equipment includes large and small faceplates, graduated compound rest, follow-rest (not included on 9- and 11-inch lathes), adjustable stop for thread cutting, semi-machined chuck-back, gear guards, wrenches, and double-friction countershaft.

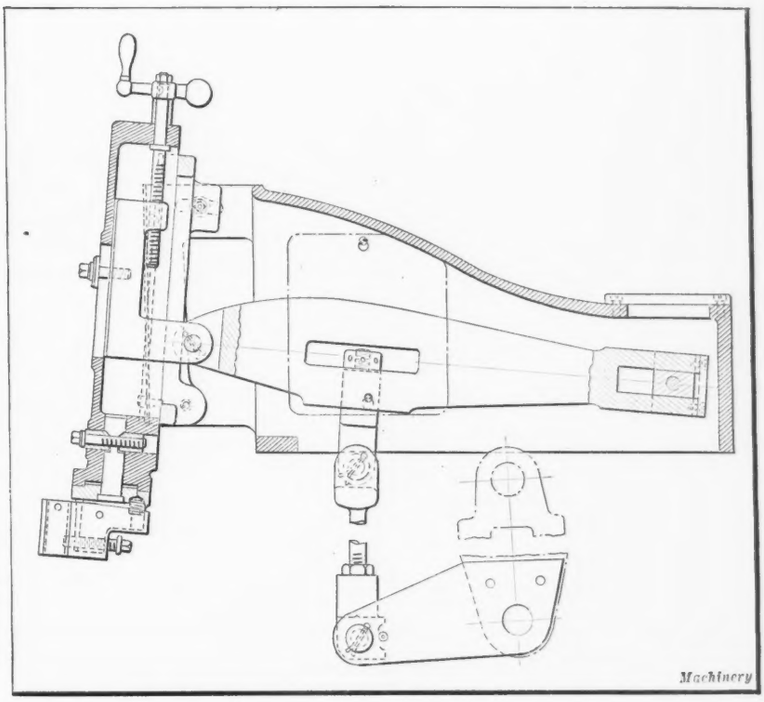


Fig. 2. Details of Vertical Shaper Attachment developed by L. E. Rhodes

RHODES VERTICAL SHAPER ATTACHMENT

To enable operations usually performed on shapers of the vertical type to be done on horizontal shapers, L. E. Rhodes, 51 Oak St., Hartford, Conn., has developed a vertical attachment that can be quickly applied to any of the standard types of crank shapers. This attachment is shown in the accompanying illustrations. The housing which contains the vertical ram and its necessary mechanical parts is made to fit in the ways occupied by the regular horizontal ram. This housing can be adjusted to the desired position with reference to the work, and held in that position by the regular gibs.

The installation of the attachment is a simple matter; practically all that is necessary is to remove the driving arm and attach two steel leg plates which remain on the machine permanently, screw in a connecting-rod, and insert a pin. This attachment is also provided with a rotary work-table equipped with standard index-plates.

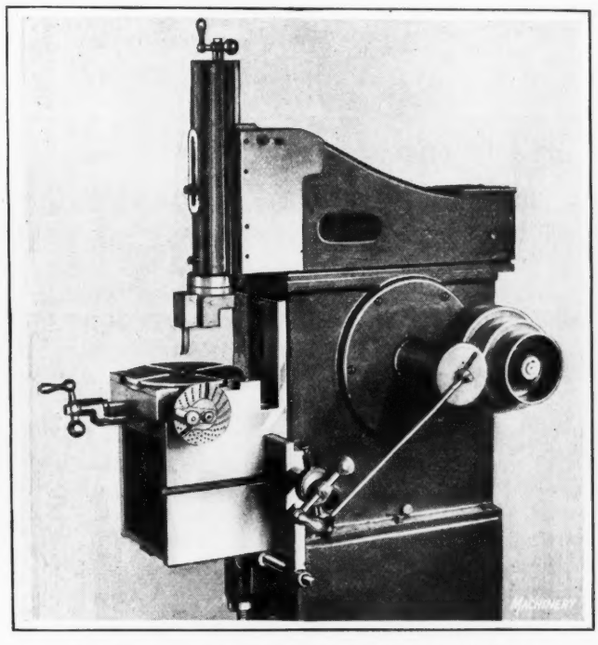


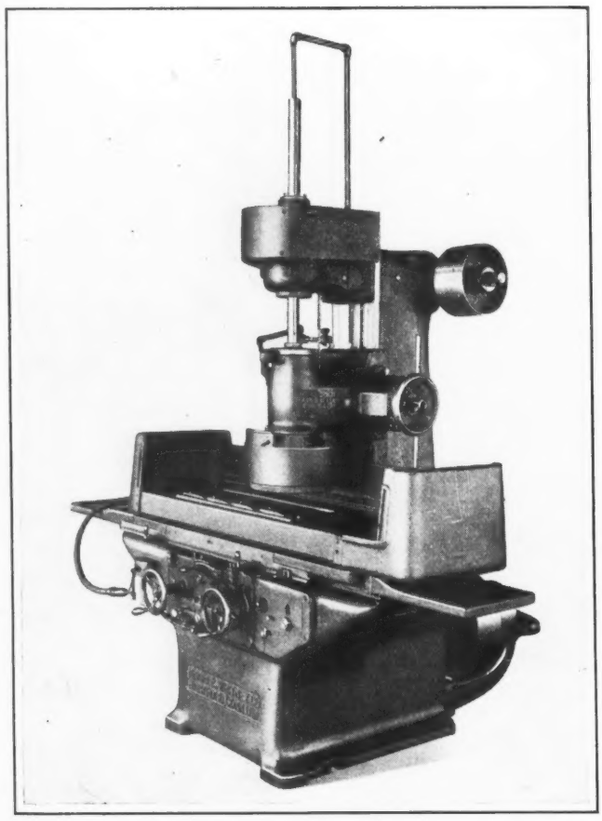
Fig. 1. Shaper equipped with Rhodes Vertical Attachment

PRATT & WHITNEY VERTICAL SURFACE GRINDING MACHINE

The 14-inch vertical surface grinding machine of the movable platen type built by the Pratt & Whitney Co., Hartford, Conn., has had a number of new features incorporated in its design. The ball bearing mounting of the spindle has been completely redesigned, the weight of the wheel unit now being carried on springs set against the upper bearings. This arrangement provides an automatic compensation for wear. The upper section of the mounting is lubricated by oil dripping from regulation oilers through the bearing, and falling into whirling cups which throw it back into the bearing by centrifugal force. In the lower section oil is poured into a large reservoir from which it flows into the upper bearing and runs along the spindle to the lower bearing. The grinding wheel faceplate acts as a retainer, and ribs in this plate continually throw the oil up into the bearing.

The table drive has been strengthened by the use of hardened shafts, gears, and clutches, and is amply lubricated from sight-feed oilers on the front of the case. The entire drive-shaft unit is easily removed through the provision of split bearings. Hand operation of the table has been simplified by the use of a sliding gear on the handwheel shaft in place of a clutch. Smoother reversing of the table is accomplished by means of a dwell in the pinion drive which permits the table to come to a stop before reversal takes place. This eliminates shock and protects the clutch mechanism. The idlers over which the main driving belt runs have been equipped with roller bearings which are lubricated by large grease cups in the ends of the stationary shaft, and the spindle driving pulley is surrounded by a heavy sheet-metal guard.

A series of baffle plates are cast integral with the tank, and these plates are provided with openings alternately at the top and bottom. The solution flows over and under these plates in such a manner that a clean solution is obtained in the last compartment from which it is drawn off by the pump. The motor drive has been improved by mak-

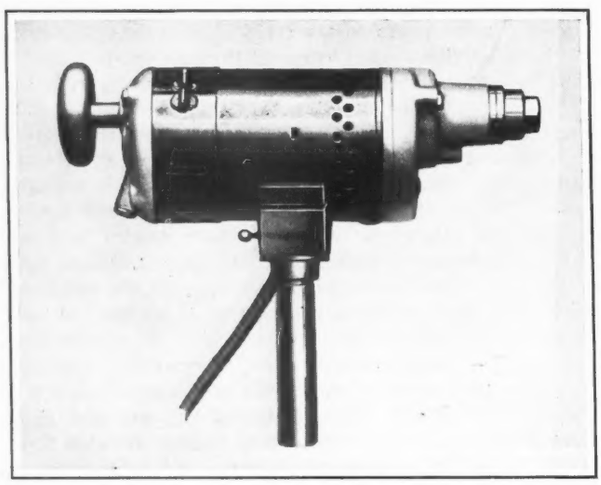


Improved 14-inch Vertical Surface Grinding Machine built by the Pratt & Whitney Co.

ing the motor base adjustable so that the driving belt may be correctly adjusted relative to the steps of the driving cone. The drive for the rotary tilting chuck is now equipped with a flexible coupling, which facilitates the mounting of the unit and the aligning of the driving shaft.

PORTABLE ELECTRIC DRILL

The Electro-Magnetic Tool Co., 2902 Carroll Ave., Chicago, Ill., has recently placed on the market a ½-inch portable electric drill. This tool has been designed to fill the requirements of garages, service stations, small machine shops, etc. A simple inexpensive stand is also made to convert the tool into a small drilling machine and so increase its usefulness. The gears are made of a high-grade steel and are hardened and ground. The spindle shaft is equipped with ball thrust bearings. The tool is controlled by a positive switch. All electrical connections are made in the switch box, the cover of which is removable to permit the reconnecting or changing of lead cords without opening the tool. The commutator may be inspected and the brushes removed by taking off a cover plate.

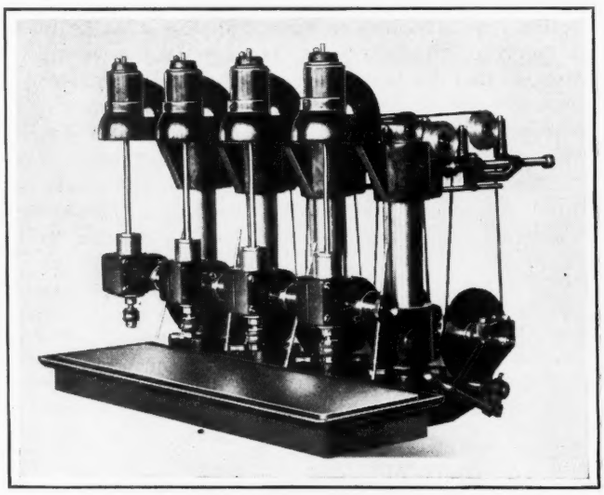


Portable Electric Drill made by the Electro-Magnetic Tool Co.

HENRY & WRIGHT BENCH MULTIPLE-SPINDLE DRILLING MACHINE

A recent development of the Henry & Wright Mfg. Co., 760 Windsor St., Hartford, Conn., is the No. 0 bench multiple-spindle drilling machine illustrated. This machine is equipped with ball bearings and has a two-step pulley in each spindle drive and on the rear driving shaft. These pulleys give four speeds, of which the maximum is 12,000 revolutions per minute, and drive a 13/64-inch drill to the full capacity. The tension on the belt driving each spindle is governed by a spring that can be quickly adjusted to give the proper tension for the size of drill being used.

The lower arm has a vertical adjustment on the column of 6¾ inches, and this, together with a feed of 2½ inches, gives a maximum height of 7⅞ inches from the table to the nose of the chuck. A quick return of each spindle is secured by means of an adjustable flat coil spring connected to the pinion which operates the rack. This spring also prevents the tool breaking when the drilling of a part is completed. The machine is equipped with tight and loose pulleys and a belt shifter. Special attention is given to the alignment of all parts so that high speeds can be maintained. Each spindle is ⅜ inch in diameter, and is provided with a chuck having a capacity up to 13/64 inch. The center distance of the spindles is 7 inches and the distance from the center of each spindle to the edge of its corresponding column is



No. 0 Bench Multiple-spindle Drilling Machine manufactured by the Henry & Wright Mfg. Co.

5¼ inches. The machine occupies a floor space of 26¼ by 33 inches, has a height of 22¾ inches, and weighs about 345 pounds.

WESTINGHOUSE SAFETY MOTOR-STARTING SWITCHES

Motor-starting switches Types WK-30 and WK-55 have been added to the line of electrical equipment manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. These switches are of the quick make-and-break knife type, and are completely enclosed, being operated by an exterior handle. The WK-30 switch protects the motor from overloads, both when starting and when running, because it is equipped with thermal cut-outs that open the circuit on dangerous sustained overloads but do not operate under harmless momentary overloads. The cut-outs resemble cartridge fuses, but are not interchangeable with fuses, so that the latter cannot be substituted by error. They operate by

fusing a special washer which can be quickly replaced at a negligible cost.

On both switches all parts are enclosed so an operator cannot touch live contacts. The door to the cut-outs or fuses is interlocked with a switch that cannot be opened unless the switch is in the "off" position, when all accessible current-carrying parts are dead. If desired, the door can be padlocked to prevent access by unauthorized persons. It is also possible to lock the handle in the "off" position by three separate padlocks for the protection of those working on machinery controlled by the switch.

MELDRUM-GABRIELSON ADJUSTABLE LIMIT SNAP GAGES

Improved type "Syracuse" adjustable limit snap gages are now being manufactured by the Meldrum-Gabrielson Corporation, Syracuse, N. Y. Style A is shown in Figs. 1 and 2. The measuring pins on these gages may be adjusted to suit conditions, and then sealed over with wax to prevent tampering. The adjusting of the pins to the desired limits is a simple operation. The locking screw *A*, Fig. 2, is first loosened, and the measuring pin set by moving the split adjusting screw *B* either in or out as necessary. By then tightening the locking screw, the split adjusting screw is locked securely in place due to the action of the tapered head of the locking screw. The screw head is then covered over with sealing wax.

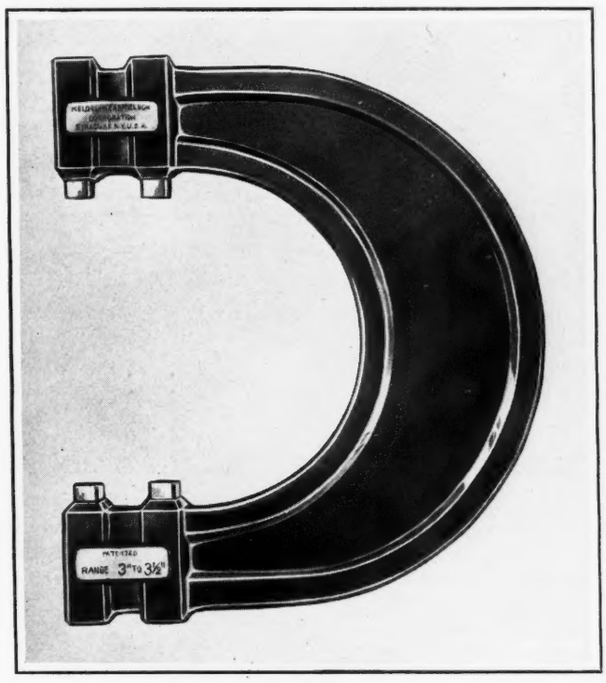


Fig. 1. Style A Adjustable Limit Snap Gage made by the Meldrum-Gabrielson Corporation

The gage is provided with square pins, and patents are held on all other styles except round. The pins are made of tool steel, and are hardened and accurately ground to a tight fit. One advantage of a square pin is that it obviates any possibility of a pin turning in its hole. This shape also presents a straight edge to the work. The amount of adjustment possible is sufficient to permit several regrindings and lappings. The frame is made of gray iron, and is reheated to relieve all strains and to season the metal. It is finished in black enamel, baked on.

A gage similar to the one described, but which is provided with rectangular pins for measuring against shoulders is also manufactured. This type is known as Style B. It eliminates the danger of work passing inspection which has an enlarged diameter adjacent to a shoulder. A third

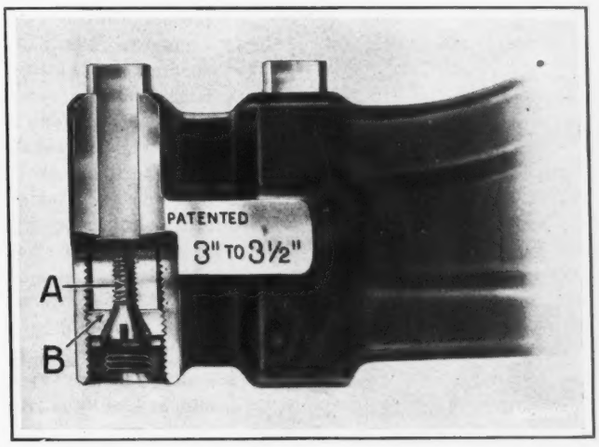


Fig. 2. View showing Arrangement for adjusting and locking Measuring Pins

type, provided with three pins and intended for use in the closer inspection of parts, is known as Style C. The outer pins of this gage are set to the "Go" dimension, the middle ones to the nominal size, and the inner ones to the "Not Go" dimension. These gages are made in twenty-four sizes, of which the smallest has a capacity of from 0 to ¼ inch, and the largest from 11 to 12 inches.

MARQUETTE EVEN-PRESSURE SPRING CUSHION

In drawing metal shells in dies, it is desirable to have an unvarying pressure during the entire stroke of the press, and in order to produce this uniform pressure, the Marquette Tool & Mfg. Co., 319-331 W. Ohio St., Chicago, Ill., has developed the spring cushion illustrated in Figs. 1 and 2. It is stated that with this device sufficient pressure is obtained at the beginning of the draw to eliminate the wrinkling of the metal and unnecessary wear on the dies. This pressure is maintained evenly at every point of the drawing operation, which avoids the straining of the metal to the breaking point toward the end of the stroke. By eliminating increased pressure at the bottom of the stroke, backlash of the press is avoided.

The cushion is attached to the press by means of a single bolt, which screws into the bolster plate or the die in the same manner that rubber bumpers or coil springs are fastened. No special drilling of the press or bolster is required, and the cushion will fit any ordinary drawing die. When the punch descends on the blank, die pins resting on a plate which, in turn, rests on spring housing *A*, Fig. 2,

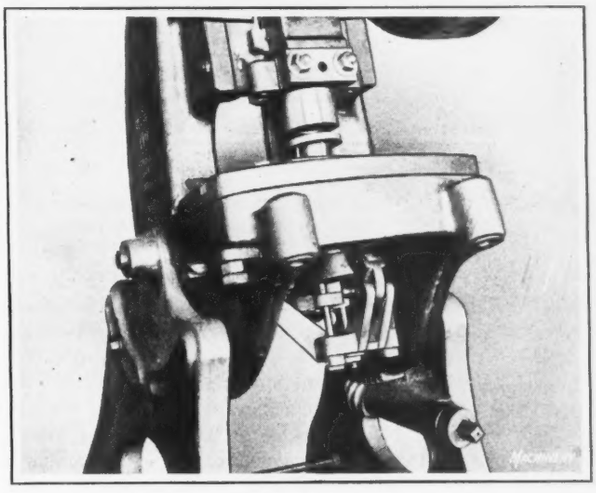


Fig. 1. Even-pressure Spring Cushion made by the Marquette Tool & Mfg. Co.

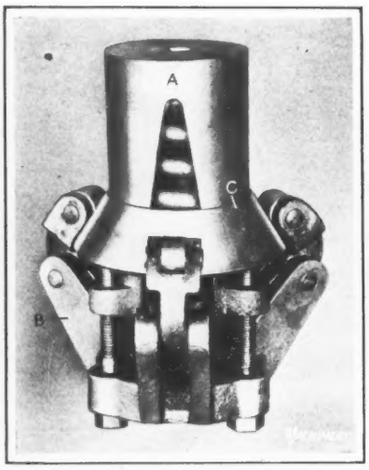


Fig. 2. Detail View of Spring Cushion

force the latter down, compressing the spring against a washer. This washer is carried by the lower ends of equalizing levers *B*. As the spring housing descends, it carries with it adjusting screws which allow the equalizing cam *C* to descend by yielding to the pressure of the rollers at the upper end of the equalizing levers. The angular surface of the cam permits the equalizing levers to swivel about their journals and the spring washer to descend, thereby causing, on a long drawing operation, only a slight compression of the spring. On a 1½-inch draw the compression amounts to only ⅝ inch. The angular surface of the equalizing cam, together with the change in the leverage of the equalizing levers as they swing about their journals during the down stroke of the press, compensates for the increase in the spring pressure made by its slight compression. During the return stroke the same movements take place in reversed order.

NORTON PISTON-GRINDING ATTACHMENT

The Norton Co., Worcester, Mass., has recently brought out a universal piston-grinding attachment which is to be supplied as regular equipment with this company's auto-part regrinding machine. This attachment facilitates the setting up of a machine for pistons of different makes. It

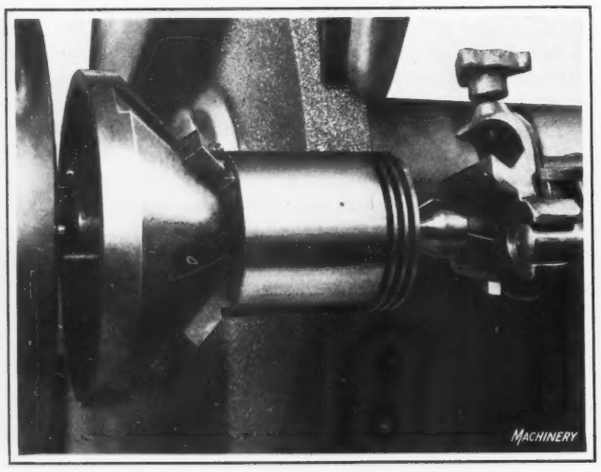


Fig. 1. Piston-grinding Attachment developed by the Norton Co.

can be used on pistons from 2¾ inches in diameter up to tractor pistons 7½ inches in diameter. The fixture can be set up in less than two minutes.

In Fig. 1 the fixture is shown in place on a machine. From this illustration it will be seen that it consists essentially of a dead center upon which revolves a cone-shaped member in which three dovetail slots are cut. In each of these slots is mounted a slidable member of hardened tool steel, the upper surface of which is ground to a conical shape. This surface is parallel to the bottom of the slot in the cone, so that the movement of the jaw is along an element of the cone. In each of these jaws is turned a transverse groove, as shown in Fig. 2, which permits the corner of the wheel to travel beyond the end of the piston without interference. The jaws are also slotted longitudinally and locked in place by a taper-pointed screw.

As the surfaces upon which the piston rests are elements of the cone, an accurate setting of the jaws is unnecessary. They are merely set by eye to bring the clearance grooves into their proper positions. The cast-iron cone revolves upon the end of the dead center on a conical bearing, and is driven by the regular drive pin extending from the face-plate of the machine into a cored slot. The piston, in turn, is driven by means of a spline made of a small piece of sheet steel screwed to the side of one of the jaws, as shown in Fig. 2. A shallow slot is filed in the skirt of the piston to engage this spline. In case the maker of a piston does not recommend slotting the skirt, a special driver can be furnished which is adjustable for all sizes of pistons.

The bearing of the cone on the dead center is tapered, and wear is taken up by adjusting a split threaded collar, immediately in back of the cast-iron piece. The slidable jaws can be readily dressed in case of wear by setting the

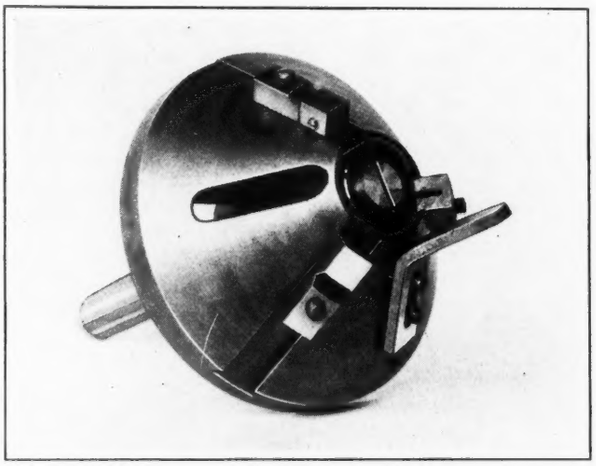
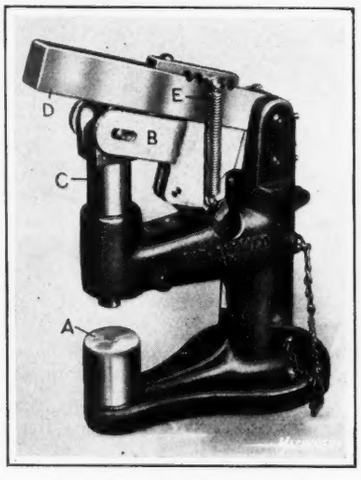


Fig. 2. Close View of Norton Piston-grinding Attachment

fixture in the adjustable center-grinding attachment which is furnished with the grinding machine. Ample oiling facilities are provided by means of drilled holes leading from the back of the center to the inside of the bearing. The attachment is known as Style No. 509.

GILES TRIP-HAMMER STAKING MACHINE

A machine designed for staking or riveting cupped or drilled rivets, studs, screws, pins, etc., in the assembly of small parts, is now being manufactured by the H. C. Giles Corporation, 303 Cox Bldg., Rochester, N. Y. The machine is particularly adapted for jobs where uniformity of the product is required and where distortion of the work is not permissible. It is operated by foot through a treadle-rod that extends through the bench on which the machine is mounted. This rod is not shown in the illustration.



Staking Machine built by the H. C. Giles Corporation

After placing the rivet or stud, and the parts to be assembled, on the staking block *A*, spindle arm *B*, and consequently spindle *C*, is brought down-

ward by operating the treadle, until a certain tension is obtained on a spring pad within the spindle and projecting from the lower end of the latter. When this tension has been secured, a latch in hammer *D*, which has been previously engaged with a stationary dog in arm *B* in such a manner that the hammer and arm are separated, is released. As this occurs, the hammer is pulled downward by two springs *E* which connect the hammer and arm *B*, and strikes a blow upon a pin projecting slightly from the top of the spindle. This pin, in turn, drives the staking set at the lower end of the spindle. A spring in the base of the machine raises the spindle after each blow.

JACKSON VERTICAL-SPINDLE MILLING MACHINES

The accompanying illustrations show improved types of vertical-spindle milling machines built by the Jackson Machine Tool Co., Jackson, Mich., for manufacturing and die-sinking purposes. The machine shown in Fig. 1 is known as the No. 6-A, and has power feeds. A machine known as the No. 5-A is similar to the No. 6-A machine except that the feeds are by hand, the table surface is smaller, and some of the traverses are less. The machines are very much the same as the Nos. 5 and 6 Jackson die-sinkers, but they are not equipped with a cherrying attachment.

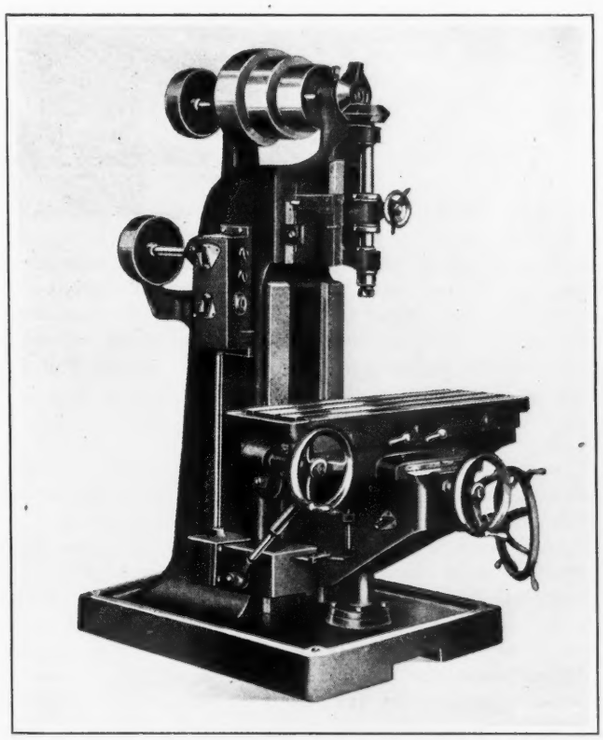


Fig. 1. No. 6-A Vertical Milling Machine built by the Jackson Machine Tool Co.

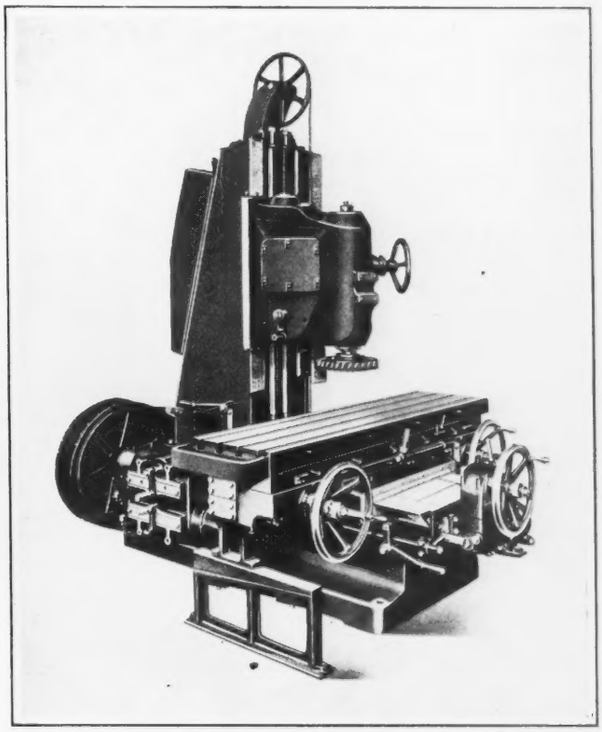


Fig. 2. No. 10-A Jackson Vertical Milling Machine designed for Production and Die-sinking

To facilitate operation, the spindle has a vertical movement, manipulated by hand through a mechanism permitting both hand feed and rapid traverse. Near the lower end of the spindle is a vertical sliding housing, which carries both the lower main spindle bearing and the thrust bearing and is operated for a slow feed by the handwheel shown at the right. The rapid traverse is obtained through a four-spoke pilot wheel located near the handwheel. The slow feed is quickly engaged or disengaged by a slight turn of a small knurled handwheel, and when the slow feed is disengaged, the rapid traverse is free to operate. The spindle and housing are counterbalanced by a weight inside the column, which is slightly greater than the weight of the spindle and attached parts, in order that all lost motion between the cutting tool and the handwheel may be taken up. A micrometer stop is provided for determining the depth of cut and the vertical position of the spindle. The spindle housing may be clamped in position for a longitudinal or a transverse cut when the proper depth is once obtained.

Fig. 2 shows the No. 10-A milling machine. Another machine known as the No. 10-B is similar to the No. 10-A, except that the latter has a table and cross-rail feed ranging from 0.001 to 0.015 inch per revolution of the spindle while the No. 10-B machine has a range of feeds from 5/16 inch to 16 inches per minute, regardless of the spindle speed. These milling machines are practically the same as the No. 10 die-sinker, the only difference being that they are provided with a head containing a heavy vertical milling spindle, whereas the die-sinker is equipped with a head containing a vertical spindle and a cherrying mechanism. Inside the milling machine head is a back-gear arrangement, whereby thirteen changes of spindle speeds ranging from 8½ to 310 revolutions per minute are obtained. A pull-pin lever on the head provides means for quickly shifting from direct to back-gear. All other speeds are secured through the change-gear box on the left-hand side of the base near the driving pulley.

The lower end of the spindle has an integral flange 6½ inches in diameter and having a ¾-inch keyway running across the face and two holes for securing and driving large cutter-heads. It also has a hole 13/16 inch in diameter running its entire length for a draw-in bolt, and a No. 13 Brown & Sharpe taper hole at the bottom. All feed changes are controlled at the feed-change box on the right-hand side of the base near the rear end. A circular table 36 inches in diameter may be provided for circular and continuous milling. This table may be used as an attachment on the milling machine table, so that it may be removed when not in use, or it may have its bearing on a specially designed cross-rail. Standard sizes of cutters are made for these machines, the cutters being 4, 6, 8, 10, 12 and 14 inches in diameter. All cutters are made from standard stock and may be used with any cutter-head. The larger heads have backing rings for more securely holding the cutters.

PRATT & WHITNEY DIE-SINKING MACHINES

Several new points in design have been incorporated in the die-sinking machines made by the Pratt & Whitney Company of Hartford, Conn., to make their operation more convenient and their maintenance easier. The driving spindle has been provided with a positive pin lock in four positions, so that the chuck or collet can be tightened without holding the driving belt. The spindle pulley has a new system of oil-grooving opposite to the direction of rotation, so that oil is continually carried upward, thus insuring complete lubrication. A floating babbitt washer takes the thrust on the spindle. The main driving cone has been fitted with a hollow spindle having communicating oil-holes that deliver oil to a series of felt-packed grooves which conserve the lubricant and guarantee an ample supply.

Leather wipers held in cast-iron caps attached to the knee protect the ways from chips and dirt. The vise capacity has been increased to accommodate larger work, and the vise has been strengthened in proportion to its greater capacity. A telescopic elevating screw is furnished in place of the old type of straight screw. The elevating wheel shaft is equipped with a thrust bearing for ease of operation. The outboard bearings for the knee and vise slides have been strengthened, and the slides are grooved and protected with covered oilers.

A cherrying attachment recently developed for use on the die-sinking machines is illustrated in Fig. 2. This attachment is pivoted in a bracket attached to the side of the column. When in the working position, the swinging arm of the attachment is doweled and clamped to a boss at the lower machine-spindle bearing. The application of the cherrying attachment does not interfere with the regular functions of the machine. When in the working position, the regular feeds are available for governing the cut, and in the non-working position the spindle is released for ordinary operations. The adjustment to either position can be readily made.

The backs of the cutter teeth are utilized for driving the cutters. These are made in the form of gear teeth and mesh with a spur pinion. Two pinions of different pitch

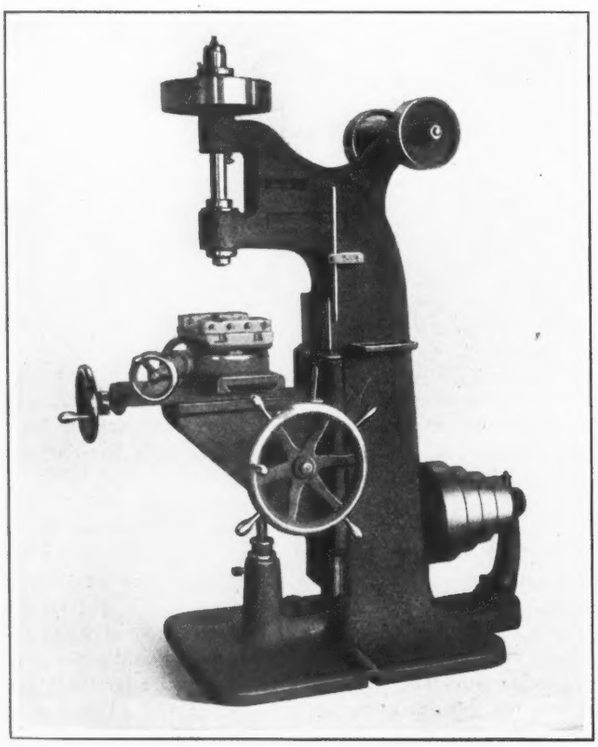


Fig. 1. Improved Die-sinking Machine brought out by the Pratt & Whitney Co.

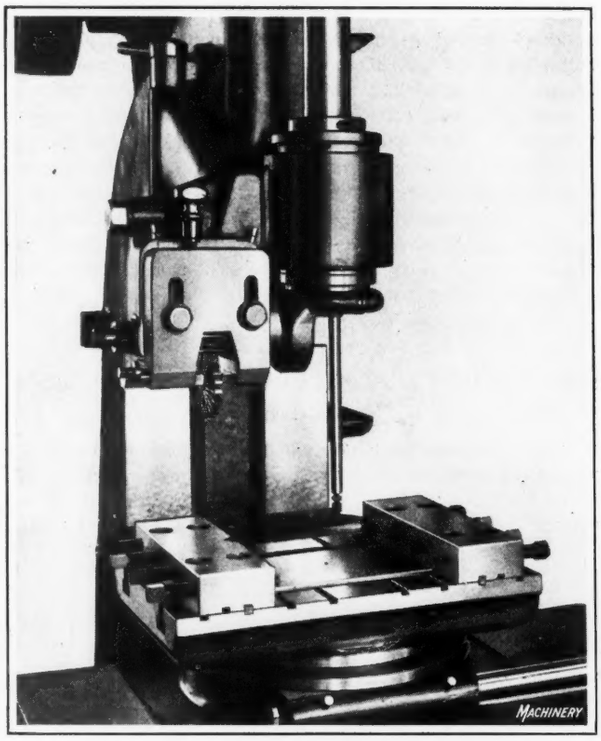


Fig. 2. Cherrying Attachment developed for Use on Die-sinking Machines

are furnished to permit a variation in tooth space on small and large cutters. Bevel gears transmit power to the cutter pinion, and the end of the machine spindle is threaded to receive the driving gear. The mating driven gear is held on the pinion-shaft by a friction which may be readily adjusted to suit conditions. This friction acts as a safety to prevent injury to cutters which might result from excessive feed or faulty manipulation.

Cutters from 1 to 6 inches in diameter can be accommodated, the cutter-slide being provided with an adjustment to compensate for the various sizes. The smaller size cutters are mounted on conical centers, while the larger sizes are provided with a comparatively small hole for which cylindrical centers are utilized. The method of mounting the cutters on centers is such that half the cutter diameter can be used. This cherrying attachment is intended for finishing operations only, and before its use the impression should be roughed approximately to shape. Stock cutters have a 7-degree angle plus a shrinkage allowance of 3/16 inch per foot. The cutters are made from carbon and high-speed steels.

BICKFORD-SWITZER TAP GRINDER

A self-contained tap grinder, equipped with a ¼-horsepower motor, for either direct or alternating current, has recently been developed by the Bickford-Switzer Co., 50 Norwood St., Greenfield, Mass. This machine is mounted on a column and weighs about 300 pounds. A good idea of its general construction may be obtained by reference to Fig. 1, while the diagram Fig. 2 shows the difference between a tap sharpened by ordinary methods and one sharpened by the new machine. The full lines show the shape of the thread after sharpening in the regular way, while the curved dotted line shows where the point of the tooth at *A* is removed when the tap is ground on the new tap grinder. In many respects the machine is similar to the drill grinder described in March MACHINERY. It is designed to sharpen any style of tap having any number of lands or flutes from two to six, inclusive, by grinding an eccentric relief on the top of the cutting lands. The machine is made to handle hand taps up to 1½ inches in diameter, tapper or machine

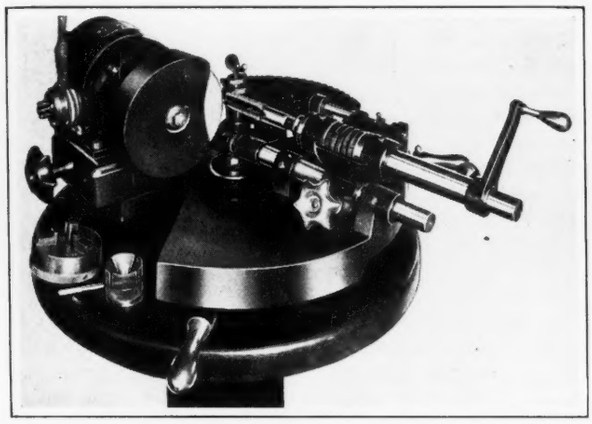


Fig. 1. Tap Grinder developed by the Bickford-Switzer Co.

nut taps up to 1¼ inches in diameter, and pipe taps up to 2 inches in diameter.

A feature of the machine is that it grinds the different lands of the tap separately and in consecutive order. A cam on the work-carrying spindle rides against a positive shoe, and causes the tap to approach, and recede from the wheel as it is revolved on its own centers. The squared end of the tap is driven by a bell center of the ordinary type, while the point end is supported by a male or female center as required. These two centers are mounted on a plate which can be revolved, or swung away from the grinding wheel to give sufficient space for inserting the shank of any long tap that it may be necessary to hold in the chuck.

The different cams employed to actuate the relief mechanism are machined on a single shell, mounted on the work-spindle in such a way that the cams do not revolve when the spindle is turned in a backward direction, but will start forward from any position when the spindle is turned forward. This arrangement facilitates the work of setting the tap so that its cutting lands will be in the proper position relative to the cam. In order to do this, it is only necessary to turn the tap backward until the contact point of the wheel is in a position between two lands of the tap and then turn the tap forward. The head which carries the main spindle can be clamped in the desired position on the rocker shaft. A flat spring which acts on the head serves to keep the particular cam in use in contact with its shoe, and a small cam-shaped collar is provided for the purpose of forcing the shoe in contact with the cam.

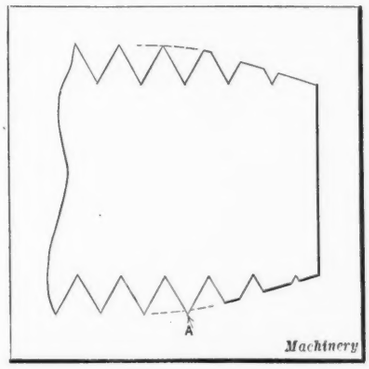
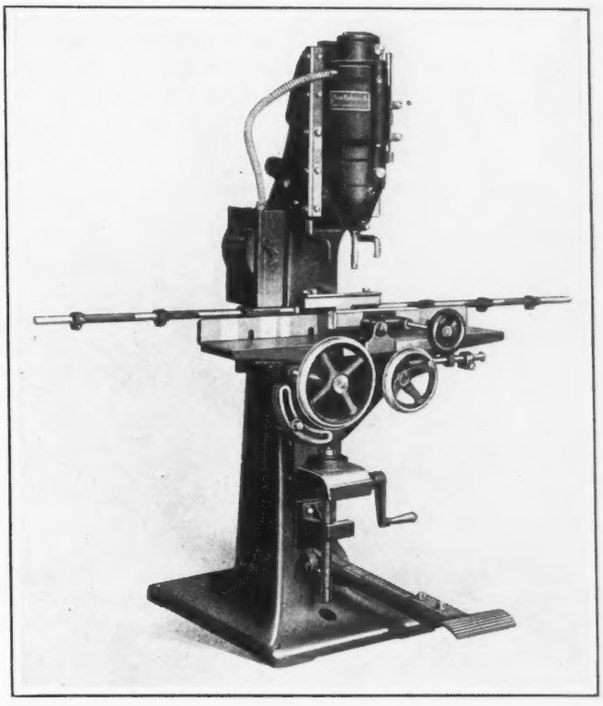


Fig. 2. Outline of Ground Tap

The machine can be used to sharpen countersinks and chucking reamers as well as taps, if they do not have more than six flutes. A lever located at the left is employed to feed the work forward into a position opposite the wheel, at which point another lever at the right of the first is used to set the work to the desired angle. The wheel is fed in as the work is revolved by means of a crank. A special feature incorporated in the machine provides for changing the angle of the work as it passes the wheel, so that a rounded contour is produced where the angle of the bevel near the end of the tap approaches the parallel sides. This feature prolongs the life of a tap and eliminates the necessity of using a hone to take off the sharp corners left on chucking reamers when the latter are ground by the usual methods.

OLIVER VERTICAL HOLLOW-CHISEL MORTISER

The illustration shows a vertical hollow-chisel mortiser on which the driving motor is built into the mortising head or ram. The motor operates on either two- or three-phase, 60-cycle current and at a speed of 3600 revolutions per minute. The machine is a product of the Oliver Machinery Co., Grand Rapids, Mich. The housing for the motor and head is in one piece, and the rotor of the motor is mounted directly on the machine spindle, which runs in high-grade ball bearings. The motor is connected by means of a flexible Greenfield conduit to a safety enclosed starting switch with fuses. This construction eliminates a countershaft, pulleys, and belts, and so saves floor space. The machine

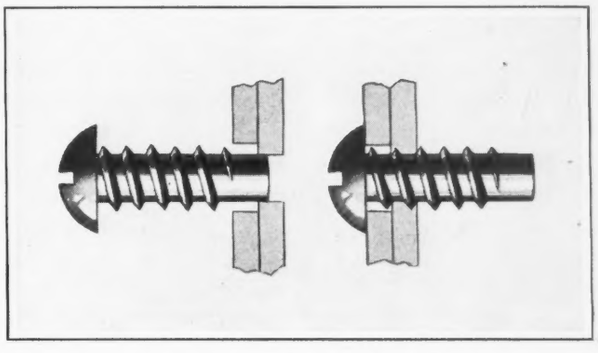


Motor-driven Hollow-chisel Mortiser built by the Oliver Machinery Co.

is equipped with a compound table having a handwheel rack- and pinion-feed and a clamp for the work. It is provided with the usual bushings, wrenches, etc.

PARKER SELF-TAPPING SCREW

A novel design of screw which requires no tapping of the hole in which it is inserted is shown in the accompanying illustration. This screw is manufactured by the Parker Supply Co., Inc., 785 E. 135th St., New York City, and will cut its own thread in die- or sand-cast parts of gray iron and softer metals, without the thread being injured. The screw has a V-thread of fairly coarse pitch and a cylindrical

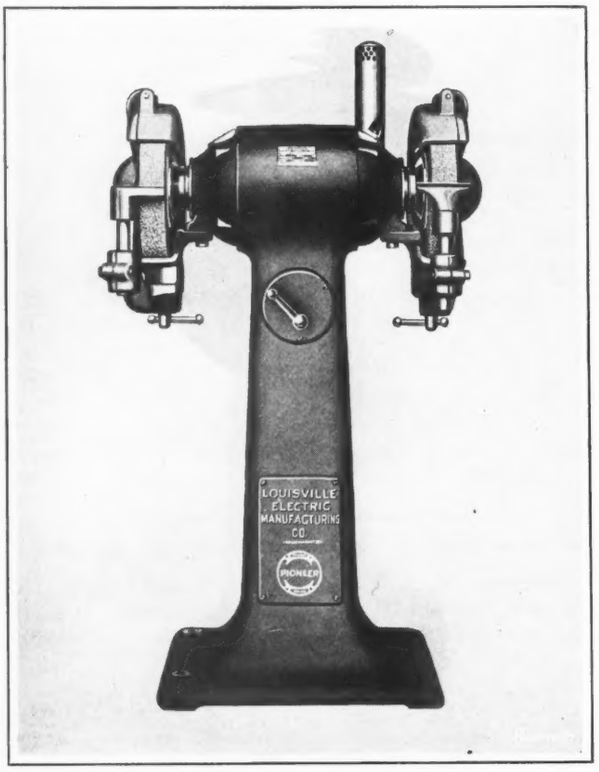


Self-tapping Screw made by the Parker Supply Co., Inc.

pilot which steadies the thread while it seats itself in the metal. In using this screw, a hole is first drilled in the piece which would ordinarily be tapped, a few thousandths of an inch larger than the pilot, and the piece to be assembled is drilled sufficiently large to provide clearance for the threads of the screw. The pilot is inserted in the hole, and with a few turns of a screwdriver, the screw is driven in place. The entire screw is hardened and heat-treated so that the thread cuts into metal similarly to a tap.

LOUISVILLE ELECTRIC GRINDING MACHINE

The Louisville Electric Mfg. Co., Louisville, Ky., has recently placed on the market the two-horsepower electric grinding machine here illustrated. It has improved ventilation, with an air intake so located that clean air is drawn through the motor. The machine can be operated continuously without exceeding temperature limits, and for intermittent duty the motor will operate safely with the air intake closed. The machine is provided with ball bearings,

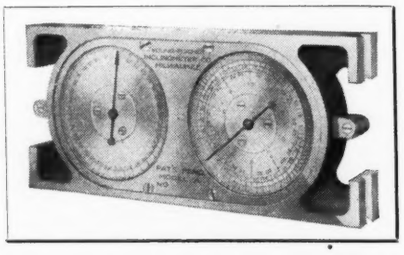


Electric Floor Grinding Machine brought out by the Louisville Electric Mfg. Co.

completely enclosed in housings. The safety hoods are made of steel and have a hinged side wall to enable wheels to be readily changed. The rests are adjustable. The motor-starting switch is enclosed in the column, and a water pot is attached to the latter. The machine is intended to be driven by either direct or alternating current. The height from the floor to the center of the spindle is 38 inches, and the wheels are 12 by 2 by 1 inch. The weight of the machine is approximately 400 pounds.

YOUNG-FISCHER "INCLINOMETER"

An instrument known as the "Inclinometer," which is intended to take the place of a plumb, level, sine-bar, and protractor in mechanical laboratories, machine shops, etc., has been developed by the Young-Fischer Inclinometer Co., Milwaukee, Wis., and is shown in the illustration accompanying this description. The instrument may be used on vertical, horizontal, and angular surfaces. It consists of an accurately machined metal case having two dials on the front face, one of which indicates angles in degrees and the other in minutes. The hand on the degree dial is fixed to the end of a small shaft on which is also attached a heavy pendulum, the result being that the hand indicates directly the number of degrees that the base of the instrument is off a true level. The minute hand is moved by a gear train that multiplies the motion of the pendulum so as to move the minute hand sixty places around the dial while the degree hand moves a distance representing one degree on its dial. A complete revolution of the minute hand represents an angular variation of 10 degrees.

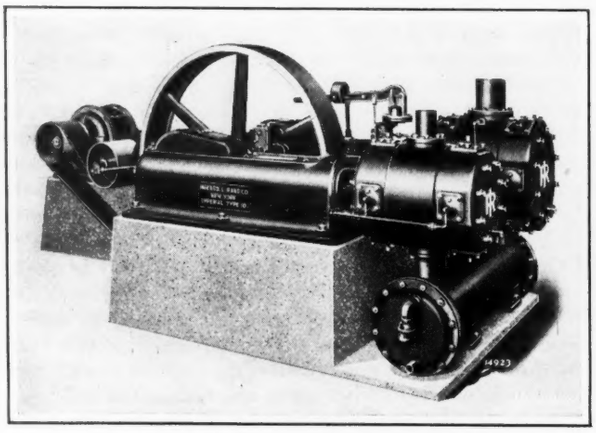


"Inclinometer" made by the Young-Fischer Inclinometer Co.

Inaccuracies due to bearing friction are overcome by mounting the bearings in rings which are concentric with the shafts and which are connected with arms or levers extending outside the case. The levers are provided with knurled handles, and in using the instrument the operator moves these handles up and down a few times, allowing the levers to strike against the ends of slotted holes in the case. The combination of the hammer effect and the oscillating movement of the bearings around the shaft eliminates retardation due to bearing friction.

INGERSOLL-RAND BELT-DRIVEN AIR COMPRESSORS

The Ingersoll-Rand Co., 11 Broadway, New York City, has announced a new line of belt-driven air compressors known as the "Imperial" Type XCB. These compressors are provided with Ingersoll-Rand plate valves for both the air intake and the discharge, and a five-step clearance control for regulating the output of the compressor. The plate valves are kept in alignment throughout their operation without wearing guides. The clearance control has been used with success on the larger direct-connected electric motor-driven compressors of this company's manufacture. This control provides a method of securing efficient operation at partial loads, as it automatically loads or unloads the compressor in five successive steps, as governed by the reduction or addition of clearance space in the air cylinders, which, of course, affects the volume of air taken in and compressed. The compressor will operate at full, three-quarter, one-half, one-quarter, and no load. At any one step the reduction in



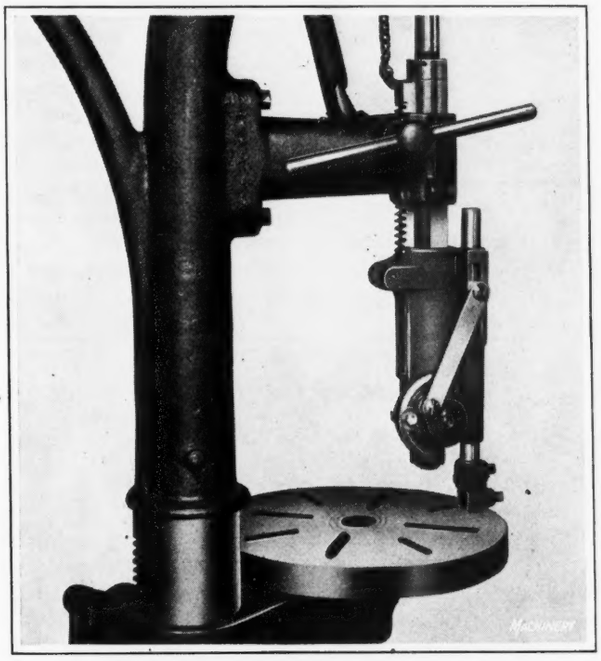
"Imperial" Type XCB Air Compressor developed by the Ingersoll-Rand Co.

input power required is in proportion to the reduction in the output capacity.

The compressors can be furnished in a single-stage style for low pressures and a two-stage style for higher discharge pressures. On a two-stage compressor clearance space in the proper proportion is added simultaneously for both the high and low cylinders, thus giving a constant rate of compression. An added feature of the control is the provision of a stop which will prevent the compressor from being operated at a load higher than desired. The piston displacement capacity for a 100-pound discharge pressure ranges from 610 to 1505 cubic feet of free air per minute. A short-belt driving attachment with a floating idler can be furnished for driving the compressor. This method of drive saves floor space and length of belt, and permits a greater arc of belt contact.

UTILITY FILING ATTACHMENT

A filing attachment designed to be employed with any make of drilling machine has been developed by the Utility Tool & Mfg. Co., 2717 Lafayette Ave., St. Louis, Mo., and is shown in the accompanying illustration. This device is

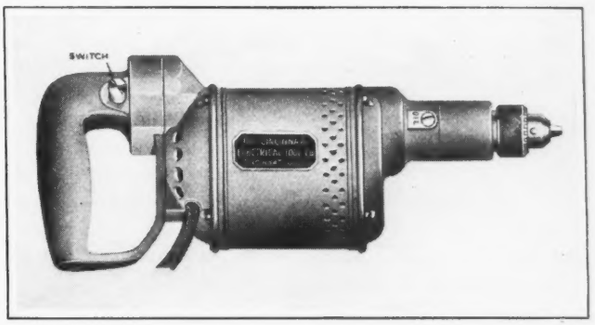


Filing Attachment for Drilling Machines, which is made by the Utility Tool & Mfg. Co.

suitable for either heavy-duty or small die work, and will accommodate any shape of file and any length up to 16 inches. The table of the drilling machine may be moved to any position, and the filing machine can be readily adjusted to any degree from 1 to 90. All gears are made of steel and are hardened and ground. In case of overstrain, a small cold-rolled pin in the shank becomes sheared, which stops the operation of the device. This pin can be easily replaced.

CINCINNATI PORTABLE DRILL

A light-weight portable electric drill of 3/16-inch capacity, provided with a pistol grip, is the latest addition to the line of tools manufactured by the Cincinnati Electrical Tool Co., 1501-1505 Freeman Ave., Cincinnati, Ohio. This drill is suitable for drilling steel, brass, aluminum, and sheet metal, and is especially intended for use in the manufacture of automobile bodies, window frames, etc. The drill is equipped with a universal motor for use on direct or alternating current of the same voltage. The motor housing, end caps,



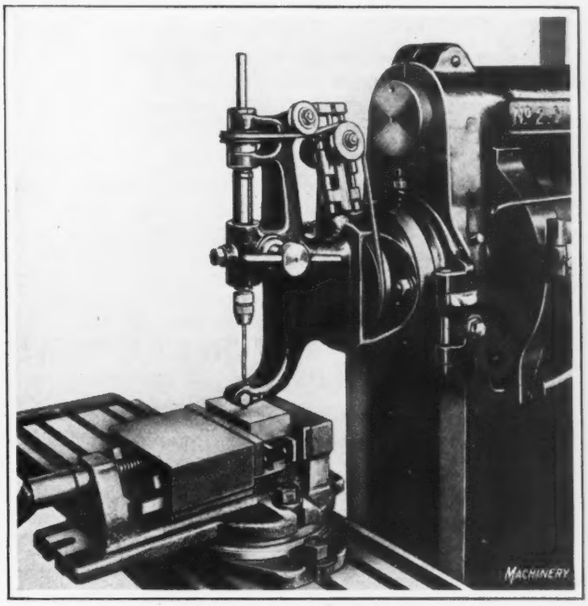
Portable Electric Drill brought out by the Cincinnati Electrical Tool Co.

and handle are made of aluminum, and the armature and gear studs are mounted on ball bearings. The switch is of the Cincinnati special quick make-and-break type, with an overload allowance of 50 per cent. It is entirely enclosed in the handle, and operated by a trigger conveniently located in that member.

KRAG SPOTTING AND ROUTING ATTACHMENT

A spotting and routing attachment designed to be mounted on milling machines for use in the accurate lay-out and drilling of holes up to and including 3/16 inch in diameter in dies, jigs, templets, master plates, etc., is here illustrated. This attachment is distributed under the trade name of "K-N" by E. L. Krag & Co., 50 W. Randolph St., Chicago, Ill. It is manufactured by Franz K. Krag, Chicago, Ill. The locating of holes by means of buttons is entirely unnecessary when this attachment is used. The attachment is securely mounted on a milling machine by means of a swinging clamp, requiring only one locking screw. It is placed in alignment permanently by means of a locating screw in the base, which is locked in place after having been adjusted.

The driving arbor for the attachment is inserted in the spindle of the milling machine, and is provided with a spring dog that engages automatically when the machine is started. The spindle of the attachment is driven by means of a round belt that is always kept at a uniform tension through the provision of a compensating spring idler, mounted in such a manner that the belt is always in alignment. The speeds of the attachment spindle and the machine spindle are in the ratio of 7 to 1. The spindle housing and the bracket which holds the guide bushings are cast



Krag Spotting and Routing Attachment

in one piece to assure alignment at all times. The spindle sleeve can be locked firmly in any desired position when using the attachment for routing by means of a friction plug. Five guide bushings, 1/16, 3/32, ⅛, 5/32, and 3/16 inch in diameter, are supplied, and these are made of a high-grade tool steel. The attachment is graduated to 360 degrees, and may be quickly adjusted to any desired angle. It is supplied for all standard makes of milling machines.

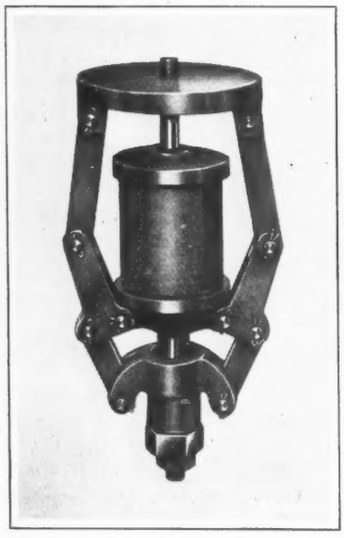


Fig. 1. Press Attachment made by the E. W. Bliss Co.

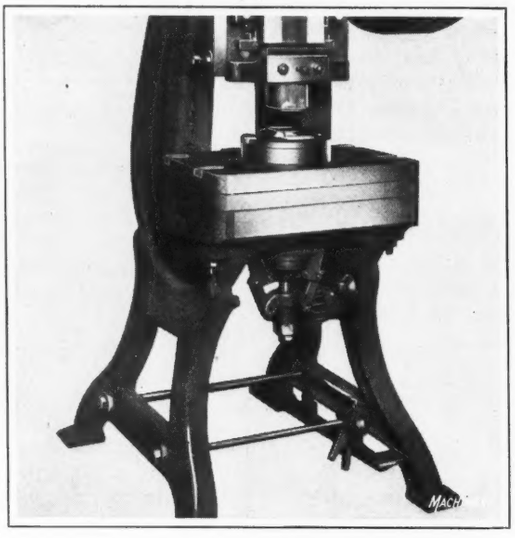


Fig. 2. Press equipped with Spring-pressure Attachment shown in Fig. 1

BLISS PRESS ATTACHMENT

The toggle-joint spring-pressure attachment here shown has been developed for use with combination dies, particularly when lithographed metal is being handled. This attachment is a product of the E. W. Bliss Co., Brooklyn, N. Y., and is intended for use with machines built by this concern. The attachment insures a uniform drawing pressure on the blank, and so increases the efficiency of the dies by minimizing the strain on the metal and reducing wrinkles and the breakage and wear of dies. The application of the toggle mechanism reduces the total rubber or spring compression. The reduced compression enables the economical manufacture of deep shells and a reduction in the number of operations required in cases where reducing operations follow the first blanking and drawing operation.

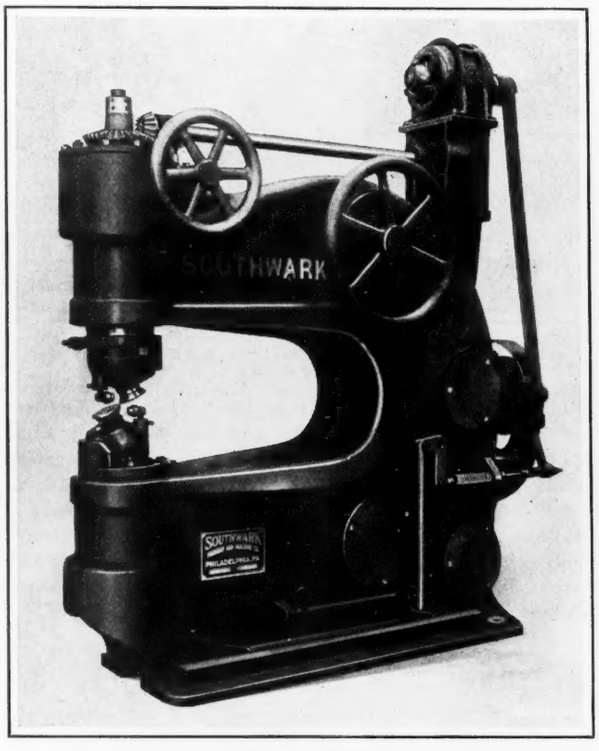
Some of the classes of work usually performed by double-action dies can be accomplished with combination and reducing dies when the presses are equipped with this attachment. The attachment is regularly built in four sizes and the depth of draw obtainable on the various sizes is as follows: No. 18 press, 1¼ inches; No. 19 press, 1½ inches; No. 20 press, 2 inches; and No. 21 press, 2½ inches. In order to have the maximum draws given, presses must have the same stroke and die space necessary with the old-style attachment. No change in the press equipment is necessary for the installation of this device.

SOUTHWARK-GRAY TURRET ROTARY SHEAR

A product of the Southwark Foundry & Machine Co., Philadelphia, Pa., known as Gray's turret rotary shear was described in MACHINERY for June, 1920. The principles of design and operation embodied in this machine have been incorporated in three new sizes of rotary shears recently developed by this company. These machines are adapted for cutting any shape of opening in sheet metal without cutting in from the edge and without turning the sheet, this method of cutting sheets and plates being made possible by mounting the rotary cutter on a turret which can be moved to any angle through a full circle while the cutting action is in process.

On the new No. 0 shear, which is the smallest of the four sizes, only the lower cutter is driven. This machine is designed primarily as a hand-driven machine, although power can be applied. On all sizes larger than the No. 0 machine both cutters are power-driven. The special feature of the largest or No. 3 machine, which is here illustrated, is the mounting of both the upper and lower cutters on adjustable turrets. This machine has a capacity for cutting any thickness of plate up to ⅜ inch. Both the upper and lower cutters are set at an angle, and they keep the same relative positions at any degree of the circle to which they may be turned. Handwheels for revolving the turrets are provided on both sides of the machine, so that the operator can control the machine from either side. The cutting speed of this machine is 10 feet per minute, and the throat depth 36 inches. Only 3 horsepower is required for driving.

The No. 2 machine has a capacity for cutting sheet metal of any thickness up to No. 8 gage, with a cutting speed of 10 feet per minute. The throat depth of this machine is 30 inches. The No. 1 machine will cut sheet metal up to No.



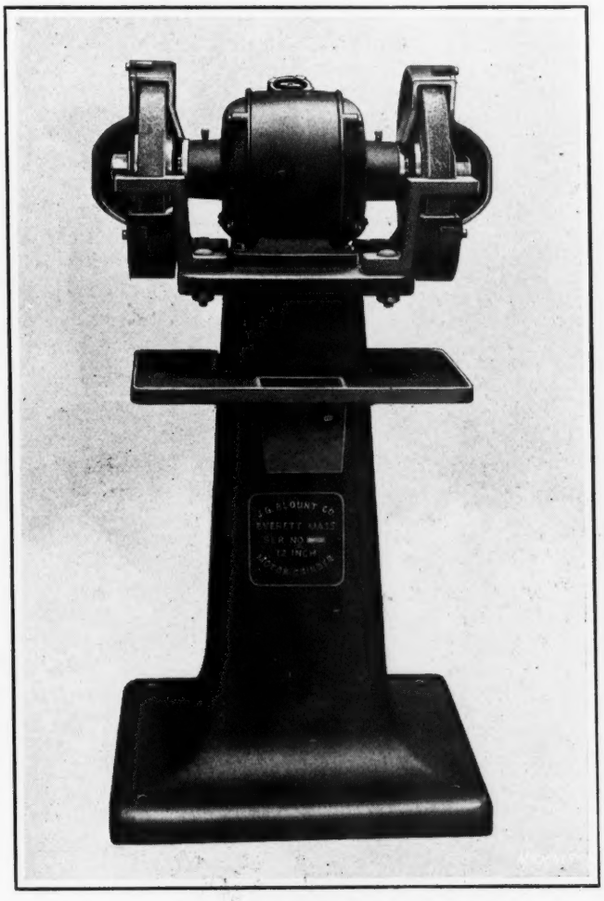
No. 3 Double-turret Rotary Shear built by the Southwark Foundry & Machine Co.

14 gage, and has a throat depth of 30 inches. The smallest or No. 0 machine will cut up to No. 16 gage, and has a throat depth of 18 inches. Special machines of larger sizes can be built to shear plates up to 1 inch in thickness. The lighter models of the turret rotary shear are employed

to cut such parts for automobiles as aprons, pans, tanks, mud guards, flanges, fenders, radiators, etc. In general sheet-metal work they are employed to cut elbows, tees, hoods, oil-pans, parts for ventilator systems, etc. The heavier models are employed to shear plates used in building ships, locomotives, boilers, etc., and in structural and ornamental iron work.

BLOUNT MOTOR-DRIVEN GRINDING MACHINES

A new line of grinding machines driven by alternating-current motors has recently been brought out by the J. G. Blount Co., Everett, Mass. The machines are built in ½-, 1- and 2-horsepower sizes. The ½-horsepower machine has 8- by 1-inch grinding wheels; the 1-horsepower machine, 10- by 1½-inch wheels; and the 2-horsepower, 12- by 1½-inch wheels. The illustration shows the 2-horsepower machine. These grinding machines are equipped with S K F ball bearings contained in dustproof mountings. The bearings are a light drive fit on the shaft, and are secured by lock-nuts. The spindles are made of a high-carbon steel, and are ground to size. The wheel flanges are machined all over, and the inner flanges are pressed to the shoulder of the spindle. The tool tray and water pot are bolted to the collar. They are separate and detachable. The tool-rests are in one piece and adjustable. Each machine is equipped with one coarse and one fine grinding wheel unless otherwise specified. The machines are driven by Westinghouse motors equipped with starting switches of the textile snap type.

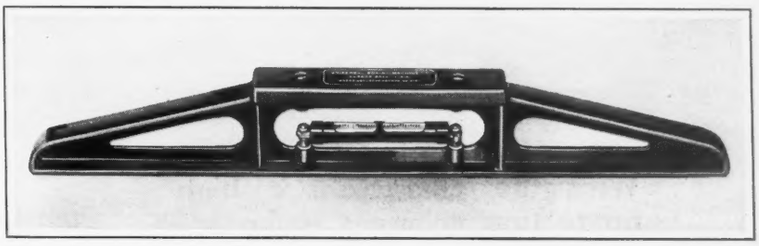


Two-horsepower Motor-driven Grinding Machine brought out by the J. G. Blount Co.

UNIVERSAL MACHINE-ALIGNING LEVEL

The Universal Boring Machine Co., Hudson, Mass., has just placed on the market a precision machine-aligning level. The frame is an iron casting of truss construction, and is of sufficient strength to eliminate strains. The leveling surface is 27 inches long. The vial is made of the best Jena glass, specially ground. It is set in a brass japanned case mounted on two lacquered brass studs which enable adjustments to be made. After being adjusted, the vial is locked in position by two nuts working against each other. The bubble in the vial has a guaranteed sensitiveness of 5 seconds of arc per graduation, this being equivalent to twenty-nine hundred-thousandths inch per foot. The manner of mounting the vial insures protection from breakage.

The level casting is insulated from the palm of the hand by means of a handle of non-conductive material and so distortion from this source is eliminated. In its manufacture, the casting is planed and drilled and then thoroughly seasoned. Subsequently, the base is hand-scraped and tested, after which it is allowed to rest for another period and is again tested. The vial is finally adjusted. The instrument is supplied in a felt-lined mahogany case, equipped with a brass handle to enable it to be conveniently carried from place to place. The level is 27 inches long and weighs about 9¾ pounds.



Machine-aligning Level placed on the Market by the Universal Boring Machine Co.

NEW MACHINERY AND TOOLS NOTES

Connecting-rod Machine: Sawyer-Weber Tool Mfg. Co., Los Angeles, Cal. A machine, the bed of which consists of a faceplate on which may be located clamps, V-blocks, boring tools, and other equipment such as required in babbitting connecting-rod bearings, straightening the rod, and boring the bearing to size.

Spring Tool-holder: Willard Tool Co., Inc., 105 E. Main St., Stratford, Conn. A spring tool-holder of the gooseneck type made of drop-forged steel and hardened to a spring temper. This holder is made in several styles and sizes, and is so designed that the tool will yield or recede in a practically straight line from the work, without causing chatter marks or breakage when taking a heavy cut.

Pneumatic Grinder: Onsrud Machine Works, Inc., 3908 Palmer St., Chicago, Ill. A high-speed grinder operated by compressed air at a pressure of 70 to 100 pounds per square inch. The complete unit weighs only 5½ pounds and is intended for small grinding wheels. Provision is made for attaching the unit to standard machine tools, but it can also be held in the hand and operated as a portable grinder.

Hardness Testing Machine: Riehle Bros. Testing Machine Co., 1424 N. 9th St., Philadelphia, Pa. A combination Brinell and scleroscope hardness-testing machine, designed primarily for the use of the Association of Manufacturers of Chilled Car Wheels in making a study of the hardness and comparative wearing and breaking qualities of chilled wheels. With this machine it is possible to employ both the Brinell and scleroscope tests on the same spot.

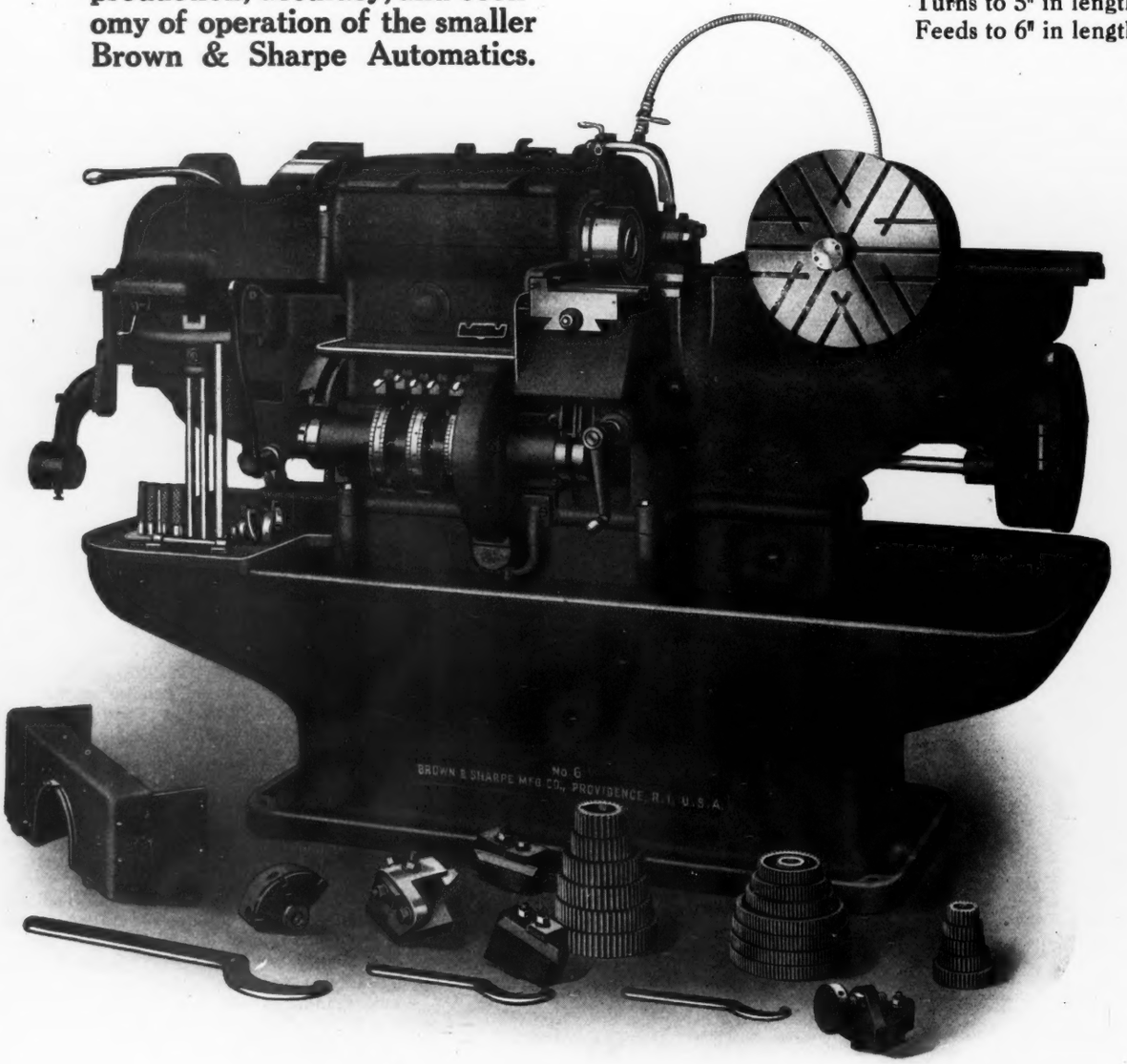
Electric Grinder: Forbes & Myers, 178 Union St., Worcester, Mass. A small grinder adapted for repair shop and garage work, whuch is supplied in either the bench or stand type. Model No. 42 is driven by a ¼-horsepower motor and is equipped with two 6- by ½-inch wheels. Model No. 62 is driven by a ½-horsepower motor and is equipped with two 6- by 1-inch wheels. The grinding wheels are mounted at each end of the motor housing. Straight-, round- or bevel-faced wheels can be supplied as desired.

for heavy work—

BROWN & No. 6 AUTOMATIC

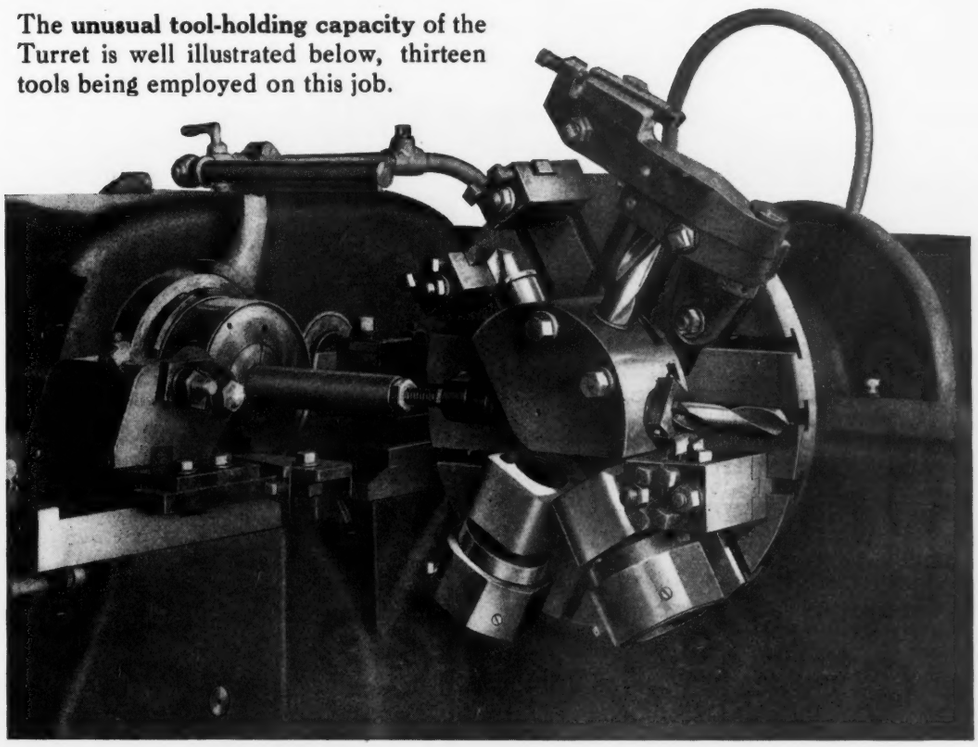
With the characteristic high production, accuracy, and economy of operation of the smaller Brown & Sharpe Automatics.

Takes work to 2" dia.
(light work to 2⅜" dia.)
Turns to 5" in length
Feeds to 6" in length



SHARPE
SCREW MACHINE

The **unusual tool-holding capacity** of the Turret is well illustrated below, thirteen tools being employed on this job.



RUGGED CONSTRUCTION. Bed, one piece casting combining spindle housings, cross slide bed, and turret slide bed.

CONSTANT SPEED DRIVE. Spindle driven through gearing and a pair of silent chains, immersed in oil. Four spindle speeds available with each set of change gears, 2 forward, 2 backward, through automatic friction clutches.

LARGE FLAT FACE TURRET. Tools bolted directly to face; allows independent adjustment of tools. Turret in vertical plane—gives ample room to swing large overhanging tools without interference with cross slides. (See above).

It is the machine you should have for economical operation consistent with the quality of work produced.

We shall be pleased to send our Screw Machine Catalog 22-G as well as supply further information about this machine

Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

PARKER-HOLLADAY POSTER SERVICE

An art poster service, for use in manufacturing plants, has been developed by the Parker-Holladay Co., 230 E. Ohio St., Chicago, Ill., which is intended to assist business men in educating their employes to think and act along constructive lines and to aid them in their advancement to more responsible positions. The service consists primarily of a series of posters, 28 by 42 inches in size, which are put up in frames and changed every week. Each poster deals with some common cause of failure for men to advance in their work and suggests methods of overcoming the trouble. The posters are printed in four colors to give them the maximum "attention value."

There are fifty-eight posters in the complete series. An oak frame is furnished for the set, which is hinged in the front, and the posters are perforated to slip over pins in the frame. An important feature of this arrangement is that the posters can be quickly put up and changed, and the same set can be used several times. In conjunction with the posters a leather-covered loose-leaf binder containing complete instructions for the application of this system is delivered to the man in charge of such work in the factory.

Who's the Loser?
Are you considering another job? If so MAKE SURE that it's to your advantage to make a change.
A man LOSES time, effort, money and prestige jumping from job to job and is soon known as a "drifter."
Your chances HERE are as good or better than they MIGHT be in the NEXT place.
WE KNOW each other. WHAT do you know about the other people?
The job with the "other firm" may SEEM better at a distance but IS it?
Perhaps it's BETTER to stay where you're KNOWN.
Don't be a "DRIFTER"

Fig. 1. Poster intended for Display in Manufacturing Plants in Cases where the Labor Turnover is Excessive

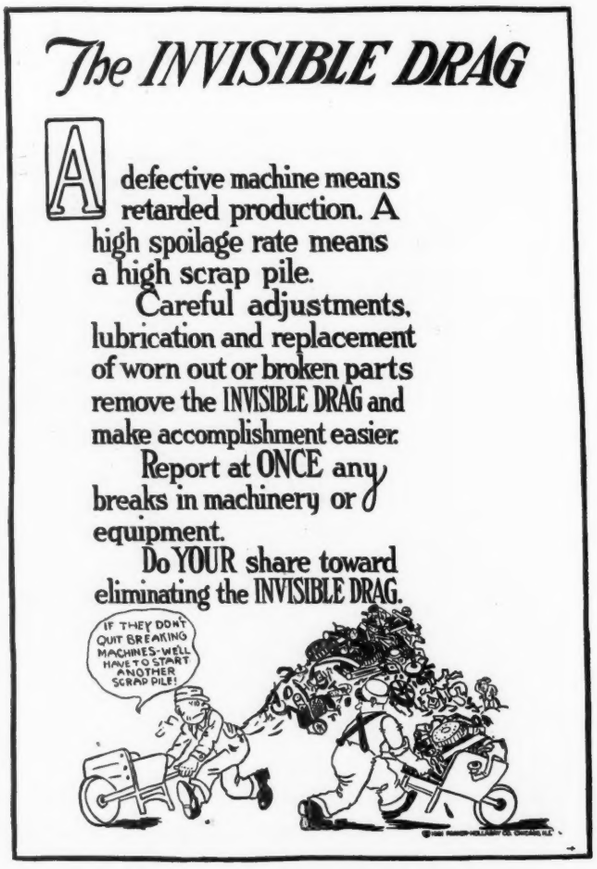

The INVISIBLE DRAG
A defective machine means retarded production. A high spoilage rate means a high scrap pile.
Careful adjustments, lubrication and replacement of worn out or broken parts remove the INVISIBLE DRAG and make accomplishment easier.
Report at ONCE any breaks in machinery or equipment.
Do YOUR share toward eliminating the INVISIBLE DRAG.
IF THEY DON'T QUIT BREAKING MACHINES-WELL HAVE TO START ANOTHER SCRAP PILE!

Fig. 2. Poster emphasizing the Need of Careful Adjustments, Lubrication and Replacement of Worn Parts of Machines

Pages are provided for what are known as "result charts" on which there are spaces for entering, in condensed form, the substance of reports sent in by the various foremen, indicating the results obtained by the posters in their departments. Such information is of definite value in using the posters a second time. For instance, suppose it is found that the labor turnover in a factory is excessive. If poster No. 17, entitled "Who's the Loser?" (reproduced in Fig. 1) had been used several months previously, and showed definite results in correcting this difficulty, the management would be justified in using this poster again with the expectation that it would overcome the trouble a second time.

For the use of foremen in making out their reports on the results obtained from successive posters put up in the factory, a special form of result chart is furnished, with spaces for entering the name of the poster, whether employes were interested, what comments were overheard, etc. The notations from these weekly result charts are summarized and entered on the permanent record sheets.

In using these posters, it is believed to be of the utmost importance to display the right poster at the right time. For instance, a poster pertaining to industrial accidents is likely to prove more effective if displayed when the thought of an accident is fresh in the minds of the workers in a factory. To obtain maximum results, it is essential for the foremen, superintendent, and other officials to show personal interest in each poster. By so doing, they will draw out remarks and discussions from the workers which will help in maintaining an accurate record of results. Illustrations are used, so that even though there may be many employes who do not read English, the subject matter of the posters will still be understood by the illustrations.

* * *

ENGINEERING EMPLOYMENT SERVICE

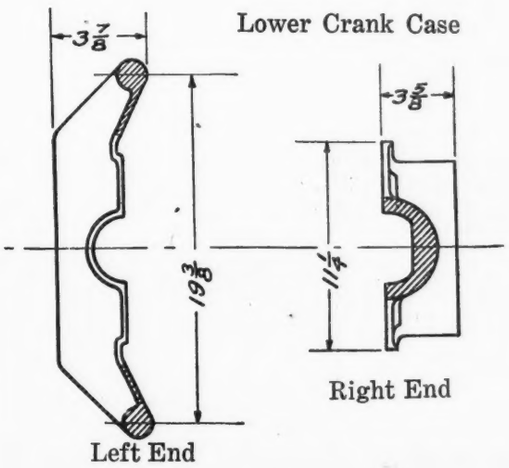
In recognition of the need of a clearing house of engineering services from which engineers of specific qualifications may be obtained, the Federated American Engineering Societies, representing a combined membership of about 50,000 professional engineers, has established at their headquarters, 29 W. 39th St., New York City, an employment bureau for engineers of every kind of training and experience. Applicants must be members and must submit a complete educational and professional record, carefully classified, so that as the special requirements of any position are received, the records of men of suitable qualifications can be submitted. The services of the bureau are free, and negotiations will be treated as confidential if desired.

Milling two parallel surfaces at one pass on the Cincinnati 48-in. Automatic Duplex Miller

Time per piece, 75 seconds. Average on a day's run, 40 pieces per hour.

The operator loads one end of the Indexing Fixture while the other end is milling.

The photograph below shows how we modified the 48 inch wide bed Duplex Miller to meet special needs.



Our Engineering Service Department modified our 48 in. Automatic Duplex to suit this job. We designed and made the fixtures and built the equipment complete ready for maximum production the minute the belt was on. These parts are cast-iron crank cases. Two surfaces at one end and one at the other are milled at one pass. The clamping arrangement is simple and the fixture inclines slightly toward the center to help in chucking. About 1/8 in. metal is removed. The thin metal section makes a relatively slow feed rate necessary. But the production is high, because—

The fixture is handy.

The Index Base allows the operator to chuck one piece while the machine is milling the other.

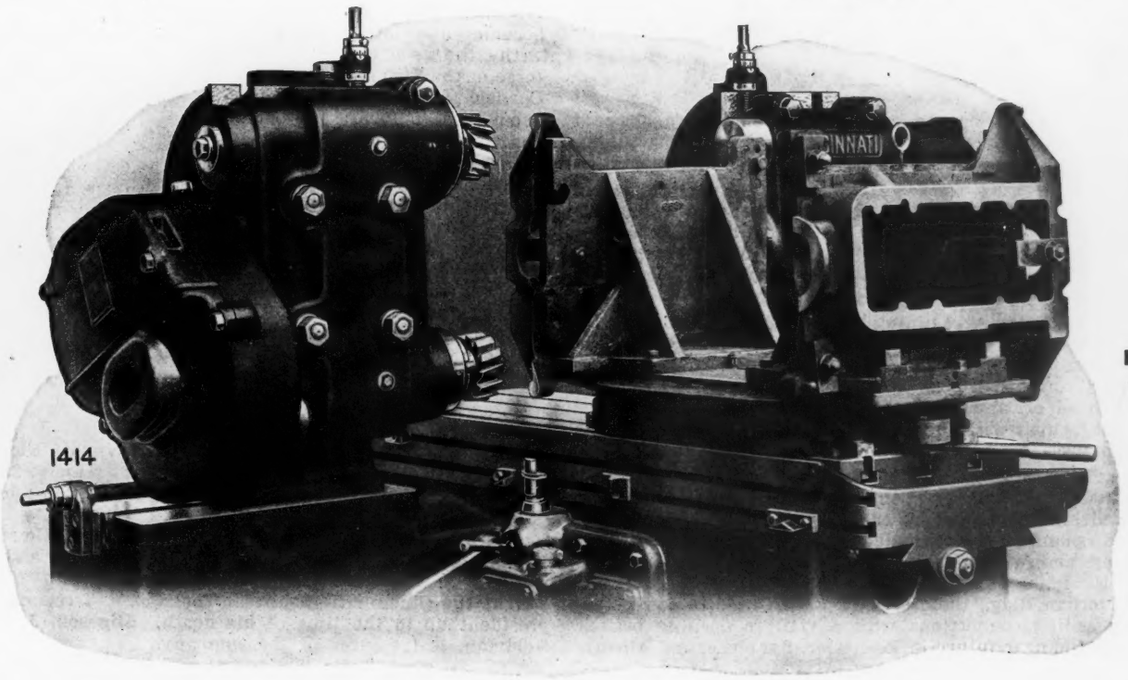
The fixture being loaded is always at the point nearest the operator.

The machine is automatic, and the operator has nothing to do but chuck and handle pieces.

All this can be applied to your work. If it requires special equipment, our Service Department will modify our Automatics to suit. Let us see your blueprints.

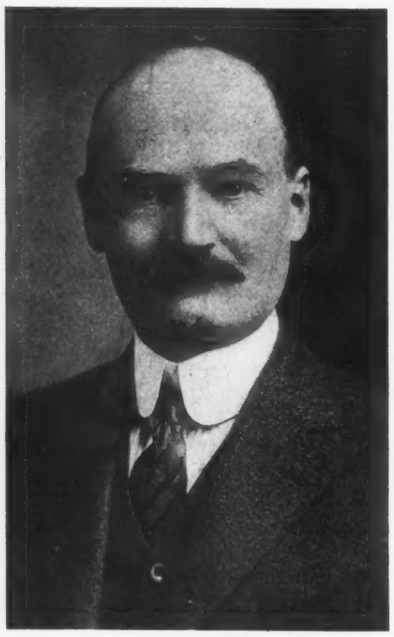
The Cincinnati Milling Machine Company

Cincinnati, O.



PERSONALS

GEORGE O. GRIDLEY has resigned as manager of the Windsor plant of the National Acme Co. His outside interests have become of such volume and importance that he has decided to devote his entire time to banking, development work, and other affairs. Mr. Gridley's work in the building up of the manufacturing organization of the Windsor plant from its small beginning to its present proportions covers a period of a quarter of a century, during which time he brought into play his ability as an inventor, a business organizer, and a financier.



Mr. Gridley was born in Harwinton, Conn., in 1869. In industrial work he was first employed by the Waterbury Button Co., and then went to Springfield, Vt., to learn the machinist's trade. He studied stenography during his leisure hours evenings, and was employed for a few months with the Jones & Lamson Co. as stenographer and office-man, also spending some time on the road as salesman. From there he went to Indian Orchard, Mass., where he started the Indian Orchard Screw Co., making bicycle parts, and later he went to Windsor, Vt., as superintendent of the Windsor Machine Co. In 1902 the Gridley single-spindle automatic was developed; later, the idea of the multiple-spindle machine was gradually evolved, until the first machine was built in 1908. From that time on the business grew rapidly.

In 1915, when the National Acme Co. took over the Windsor Machine Co., Mr. Gridley was appointed manager of the Windsor plant. Previous to that he had been vice-president and general manager of the Windsor Machine Co., and he was also vice-president of the firm of Potter, Johnson & Gridley, Ltd., of England, which built a large factory in Birmingham. This factory was taken over by the British Government at the outbreak of the war. Mr. Gridley was a charter member of the Society of Automotive Engineers. From 1917 to 1919 he served as a member of the Vermont House of Representatives. He is president of the State National Bank of Windsor.

C. B. COLE has opened a consulting engineer's office at 546 W. Washington Blvd., Chicago, Ill. He will specialize in tools, gages, interchangeable manufacture, and inspection systems.

JOHN D. HURLEY, president of the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., manufacturer of "Thor" air and electric tools, returned on September 9 from a six weeks' trip abroad, during which he visited all the principal points of continental Europe.

OGDEN R. ADAMS, machinery merchant, of Rochester, N. Y., has been elected president and general manager of the Seneca Falls Mfg. Co., Seneca Falls, N. Y., manufacturer of "Star" and "Short-cut" lathes. Mr. Adams still remains at the head of, and actively identified with, his Rochester business, which will not be interrupted in any way by his new connection.

ROBERT L. CRANE, for twenty-three years western New York manager of Henry Prentiss & Co., Inc., Buffalo, N. Y., and well known throughout the United States as a machine tool salesman, has terminated his connections with that company and will continue in the same line of business under the name of Crane Machinery Co., with offices at 501 D. S. Morgan Bldg., Buffalo, N. Y. Mr. Crane is now establishing selling connections with a view to opening branch offices in the near future in Rochester, Syracuse, and Albany.

W. LA COSTE NEILSON has been appointed general sales manager of the Norton Co., Worcester, Mass., succeeding Carl F. Dietz, who has left the Norton Co. to become president and general manager of the Bridgeport Brass Co., Bridgeport, Conn. Mr. Neilson has been with the Norton Co. for fourteen years. For a few years he was assistant sales manager, and later was placed in charge of all foreign business, including the sales and management of the two foreign plants of the Norton Co. at Wesseling, Germany, and La Courneuve, France, his office being located in London, England. He was made a vice-president of the Norton Co. two years ago. Mr. Neilson returned to Worcester last month, and took charge of the general sales October 1. He will, in addition, continue to look after the company's foreign interests.

CARL F. DIETZ has resigned as vice-president and general sales manager of the Norton Co., Worcester, Mass., to become president and general manager of the Bridgeport Brass Co., Bridgeport, Conn., his new duties being assumed October 1. Mr. Dietz has been connected with the Norton Co. for ten years, first as plant engineer, then as assistant sales manager, and later as sales manager of the wheel division. Two years ago, when the Norton Co. and the Norton Grinding Co. were consolidated, he became vice-president and general sales manager of the entire business, including both wheels and machines. Mr. Dietz graduated from Stevens Institute of Technology in 1901, and subsequently took post-graduate courses in Berlin, Germany, in metallurgy and mining. He has been employed by the U. S. Steel Corporation, and has designed and built modern ore milling plants for the American Glue Co., the Grasselli Chemical Co., and the Ozark Smelting & Mining Co. In 1908 he became consulting engineer for the Minerals Separation, Ltd., London, and in the interest of this company developed treatment methods for iron ore deposits in Norway, and studied ore treatment methods for properties in Russia, South America, Australia, and Africa.

* * *

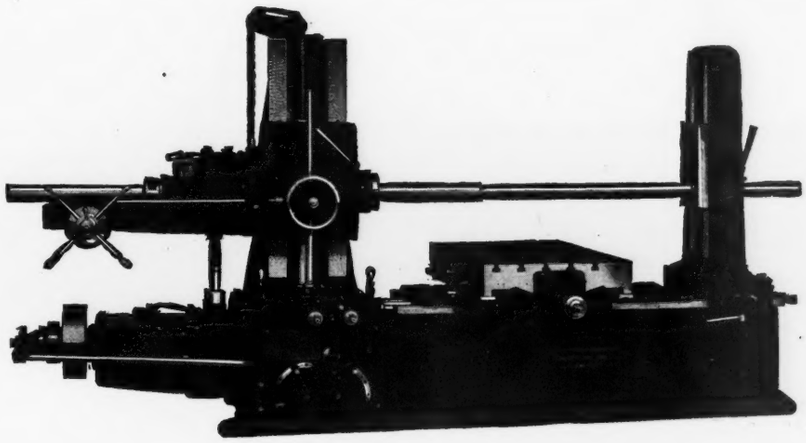
OBITUARIES

P. M. FOWL, president and general manager of the Cadillac Tool Co., Detroit, Mich., died August 24, following an operation for appendicitis, at the Harper Hospital of Detroit. Mr. Fowl was born in 1883 at Elyria, Ohio. He started work in several of the plants in the vicinity of Elyria, and in 1907 went to Detroit, where he was connected for a short time with the Ford Motor Co., and the Burroughs Adding Machine Co. He became associated with the sales force of the Strong, Carlisle & Hammond Co. in 1909, and from that time on became well known throughout the machine tool industry. From 1914 to 1917 he was the Detroit manager of the Strong, Carlisle & Hammond Co., and upon leaving that concern became president and general manager of the Cadillac Tool Co. He was also president of the Detroit Garage Equipment Co. His wife and one daughter survive him.

LOUIS J. GOLDMAN, president of the Cincinnati Electrical Tool Co., Cincinnati, Ohio, died in that city August 22. Mr. Goldman was born in New York City in 1850. When he was two years old his father died, at which time the family moved to Cincinnati, and Mr. Goldman has lived there ever since. At the age of fourteen, he started to work and later engaged in the wholesale clothing business. In 1910 he bought the Cincinnati Electrical Tool Co., and remained its president up to the time of his death. His son, J. Albert Goldman, is treasurer of the company.

THE MOST EFFICIENT MAN IS THE MAN WITH AN IDEA
and the most efficient machine is the machine made around an idea and not made merely to sell. Such a machine is the

"Precision" BORING, DRILLING & Milling Machine



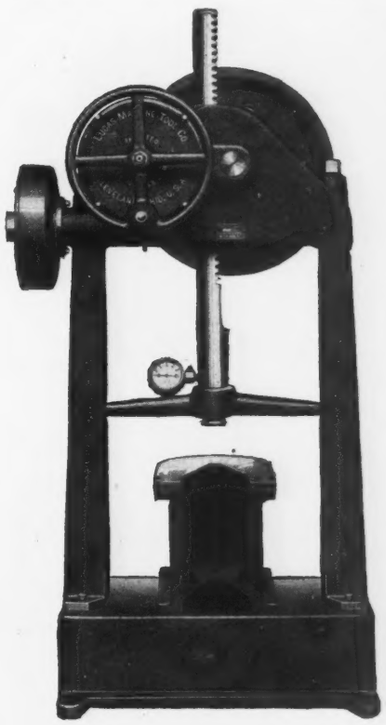
"Its Record is our Best Ad"

Now Is The Time

when almost everybody seems inclined to

SQUEEZE

things a little. If you have any *mechanical squeezing* to do, try the



LUCAS Power Forcing Press

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

COMING EVENTS

October 3-4—Regional meeting of the American Society of Mechanical Engineers in Cleveland, Ohio; headquarters, Hotel Winton.

October 5-6—Twelfth annual convention of the American Manufacturers' Export Association in New York City; headquarters, Waldorf-Astoria Hotel. Secretary, A. W. Willmann, 160 Broadway, New York City.

October 5-7—Fifth annual convention of the Society of Industrial Engineers in Springfield, Mass.; headquarters, Hotel Kimball. Office of the society, 327 S. La Salle St., Chicago, Ill.

October 17-22—Twenty-fourth annual convention of the American Mining Congress in the Coliseum, Chicago, Ill. In conjunction with the convention there will also be a national exposition of mines and mining equipment.

October 17-22—Twenty-seventh annual convention of the National Hardware Association of the United States in Atlantic City, N. J.; headquarters, Marlborough-Blenheim Hotel. Secretary, T. James Fernley, 120 High St., Boston, Mass.

October 17-22—National exposition of mines and mining equipment in Chicago, Ill., under the auspices of the American Mining Congress, Washington, D. C.

October 18-20 — Annual convention of the National Machine Tool Builders' Association in New York City; headquarters, Hotel Astor. General Manager, Ernest F. DuBrul, 817 Provident Bank Bldg., Cincinnati, Ohio.

November 1-4—Annual convention of the Industrial Relations Association of America in New York City; headquarters, Waldorf-Astoria Hotel. Acting executive secretary, E. A. Shay, 671 Broad St., Newark, N. J.

November 2-4—Fall conference of Industrial Cost Association in Pittsburg, Pa. Headquarters of the association, 2828 Smallman St., Pittsburg.

November 4-5—Regional meeting of the American Society of Mechanical Engineers in Kansas City, Mo.

December 1-3—Fall meeting of the Taylor Society in New York City. Secretary, Harlow S. Pearson, 29 W. 39th St., New York City.

December 6-9—Annual convention of the American Society of Mechanical Engineers in the Engineering Societies' Building, 29 W. 39th St., New York City.

May 8-11, 1922—Spring meeting of the American Society of Mechanical Engineers in Atlanta, Ga. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

NEW BOOKS AND PAMPHLETS

Welding and Cutting. By Fred E. Rogers. 95 pages, 6 by 9 inches. Published by the Davis-Bournonville Co., Jersey City, N. J. Price, $1.

This is an instruction book on oxy-acetylene welding and cutting and is intended for operators who have mature judgment and some knowledge of metal-working practice. The book is intended to supplement personal instruction and refresh the memory on points of practice not in daily use. It contains eight parts, treating of the setting up of welding and cutting equipment; instructions in welding, including handling of the torch, preparing work for welding, size of tip and flame, etc.; general welding practice; boiler and tank welding; welding machines; oxygen cutting; mechanically operated cutting torches; and the generation of gases.

NEW CATALOGUES AND CIRCULARS

Sterling Grinding Wheel Co., Tiffin, Ohio. Circular containing grading tables, price lists, and speeds for Sterling grinding wheels from 1 to 60 inches in diameter and from ¼ to 4 inches in thickness.

Electric Controller & Mfg. Co., Cleveland, Ohio. Bulletin 1002-A, containing information on the application, design, and advantages of Dinkey ventilated controllers for alternating-current, slip-ring motors.

Michigan Stamping Co., Detroit, Mich. Bulletin 10, illustrating and describing wiring fittings, including outlet boxes, stamped steel fixture studs, covers for outlet boxes, sectional switch boxes, and panel surface cabinets.

General Electric Co., Schenectady, N. Y. Bulletin 46041, descriptive of the Type H2 alternating-current temperature indicator for transformer windings, the purpose of which is to safeguard transformer units from deterioration due to overheating.

Ingersoll Milling Machine Co., Rockford, Ill. Circular illustrating an Ingersoll 42-inch continuous rotary continuous milling machine machining the sides of both ends of connecting-rod forgings, a production of forty-seven connecting-rods an hour being attained with the equipment shown.

E. J. Kruce & Co., 960 Harper Ave., Detroit, Mich. Circular illustrating and describing the Kruce spiral expansion reamer, which is equipped with an improved expanding device giving a greater range and insuring concentric expansion. These reamers are carried in sizes from ½ to 2½ inches in diameter, and the circular gives prices for the various sizes.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Leaflet 1888-A, describing the applications of storage battery mine locomotives, and illustrating the Baldwin-Westinghouse type of apparatus. Leaflet 1610-C, describing in detail the features of Type A auto-starters, including the auto-transformer, switching mechanism, contacts, overload relays, etc.

Hart Roller Bearing Co., Orange, N. J. Booklet entitled "Prepare for a Boom," containing an article showing the need of installing improved equipment in readiness for renewed business activity. The circular also contains illustrations of Hart staggered roller bearings, and a description of the design, material, workmanship, and application in different classes of machines.

Taft-Peirce Mfg. Co., Woonsocket, R. I. Bulletin 110, containing a detailed description and illustrations of many interesting applications of this company's entire line of production and inspection tools, including sine bars, sine bar fixtures, taper test gages, V-blocks, equalizing jaws, parallels, toolmakers' adjustable knees, universal right-angle irons, measuring irons, bench plates, universal squares, etc.

Norton Co., Worcester, Mass. Calendar for the year August 1921 to August 1922. On the twelve sheets of the calendar are listed the various products of the company, including multi-purpose grinding machines; alundum and crystolon wheels; refractories and laboratory ware; floor stands; grinding wheel dressers; machines for grinding cams, crankshafts, and crankpins; automobile part regrinding machine for repair shops, etc.

Mattingly Automatic Valve Co., Inc., 201 Chouteau Trust Bldg., St. Louis, Mo. Pamphlet containing a description of the construction and operation of Mattingly automatic valves for water gages on steam boilers, ammonia pipes, steam pipes, hose lines, etc. These valves have been designed especially to provide for the safe operation of steam boilers and conducting of fluids under pressure, by preventing false registration of the fluid in the gage glass.

Binghamton Electric Truck Co., Inc., Binghamton, N. Y. Circular containing description and specifications of the "Ideal" industrial trucks and tractors, the main features of which are as follows: A complete power unit mounted on trunnions and interchangeable in all models; a hill-climbing device making possible normal ampere construction on steep grades; an electrically welded frame; ball bearings for all the working parts; and a uniform over-all width for all types of 34 inches.

Edison Lamp Works of General Electric Co., Harrison, N. J. Bulletin entitled "Railway System Lighting Buildings and Yards," containing an article on modern lighting practice in railway shops, terminals, yards, etc., and equipment needed. Pamphlet entitled "Reflectors for Incandescent Lamps," containing a general discussion, classification of reflectors, and illustrations and data covering different types for a wide range of applications, including industrial plants, commercial lighting, etc.

Heald Machine Co., 16 New Bond St., Worcester, Mass. Circular treating of common automobile engine troubles, and describing how they can be corrected by regrinding. The advantages of the grinding process for machining worn or scored cylinders and for finishing new cylinders are pointed out, and a list is given of some of the automobile engines in this country and Europe whose cylinder bores are finished by grinding. The circular illustrates Heald regrinding machines in use in several plants, and describes the process of regrinding.

Flexible Steel Lacing Co., 4622 Lexington St., Chicago, Ill. Book entitled, "Short Cuts to Power Transmission," which is intended to answer many questions relative to the successful operation of belt-driven machinery. The book describes all types of belting and lacing, and contains belting problems and simple calculations. It also gives information on direction to run splices, belt dressings and preservatives, care of beltings, determining horsepower, figuring the size belt to use, margin of safety, etc. Copies will be sent free upon request.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 232, entitled "The Variety of Furnace Design." This pamphlet is the third of a series dealing with the fundamentals that influence the quality and cost of heated products. It discusses the relation of type and arrangement of heating equipment to cost of production, and the many factors that must be considered in adapting such equipment to individual manufacturing conditions. It contains fourteen pages of illustrations of different types of furnaces designed to meet industrial heating requirements. The section dealing with the relation of type and arrangement of furnaces to cost of production should be of particular interest at this time.

TRADE NOTES

V. Lowener, 114 Liberty St., New York City, requests manufacturers of looms for fence wire weaving to communicate with him.

C. N. Cady Co., Canastota, N. Y., manufacturer of one- and two-cylinder two-cycle engines and four-cylinder four-cycle engines, announces that an addition to the factory has recently been completed, and that it is intended to employ an additional number of men in the new building. The company has at the present time from eight to ten months work ahead.

Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill., reports that it has recently received a large contract for supplying the elevating and conveying machinery for two locomotive coaling stations for the New York Central Railroad Co., to be located at Solvay and Wayneport, N. Y. The equipment includes gravity-discharge elevator-conveyors, apron conveyors, track hoppers, etc.

Heller Bros. Co., Newark, N. J., announces that the Rex File Co. and the Vixen Tool Co. have become consolidated with Heller Bros. Co. It is believed that this consolidation will result in better service to both dealers and consumers. Walter D. Craft, who has been secretary-treasurer of the Vixen Tool Co. for some time, will act as domestic sales manager of the consolidated companies.

Lumen Bearing Co., Buffalo, N. Y., manufacturer of "Machinebronze" brass and bronze castings and bearings, solders, and babbitts, has found it necessary owing to the increase in its activities, to locate a branch office in Chicago at 15 N. Jefferson St., which will handle the western business of the company. H. S. Huncke is western sales manager, and Henry Waters, associate salesman.

Alexander Milburn Co., Baltimore, Md., announces that it has received two large contracts for oxy-acetylene welding and cutting equipment from the Baltimore and Ohio Railroad, and the Western Maryland Railroad. The contracts call for a number of Milburn "Cut-Weld" combination cutting and welding torches. These torches can be transformed instantly from the cutting to the welding type by merely changing the tip.

Surface Combustion Co., Inc., 366 Gerard Ave., Bronx, New York City, announces that it is now represented in all the principal European countries, and many large industrial furnace installations have been made. The Compagnie Generale de Construction de Fours, 32-34 Rue de la Grange-aux-Belles, Paris, France, is the sole licensee and manufacturer for the Surface Combustion Co.'s apparatus in France and its colonies, Belgium, Holland, Switzerland, Italy, Spain, and Portugal. British Furnaces, Ltd., Millbank House, 2 Wood St., London, S. W. 1, England, was organized in July for the purpose of manufacturing and selling the Surface Combustion Co.'s apparatus in the British Empire.

Firth-Sterling Steel Co., 312 Hudson St., New York City, announces that the agency arrangement for the sale of sheet-steel that heretofore existed between Thomas Firth & Sons, of Sheffield, an associated company, and Wheelock Lovejoy & Co., of New York and Cambridge, has been terminated, and Horace C. Hides, of Hartford, Conn., who for the last twenty years has represented William Jessop & Sons, has been appointed general sales manager of Thomas Firth & Sons for the United States. A stock of Firth Sheffield sheet steel will be carried in the New York warehouse of the Firth-Sterling Steel Co. Thomas Firth & Sons and the Firth-Sterling Steel Co. are also opening a joint office in Hartford, Conn., where Mr. Hides will have his headquarters and where Henry I. Moore will represent the Firth-Sterling Steel Co.

Henry & Wright Mfg. Co., Hartford, Conn., has been reorganized. The new president of the company is Charles J. Sorrells, senior partner of C. S. Sorrells & Co., New York City; and the vice-president is Jonas O. Hoover, lawyer and business man of Chicago, Ill. Mr. Hoover will also act as attorney, and as chairman of the executive committee, and expects to reside in Hartford after January 1. T. B. Owens, president and owner of T. B. Owens & Co. of New York City, is treasurer, and Mrs. Daniel M. Wright, secretary. Frank M. Rogers, formerly of Chicago, is general manager and assistant treasurer, having assumed his duties on August 1. All the stock of the company is held by the officers mentioned. William G. Allen of Hartford, Conn., the inventor of the Allen screw machine, will be superintendent and factory manager. When business returns to normal, the company proposes to build a factory equal in size to its present building for the development of the Wright dieing machine, invented by the late Daniel M. Wright and later redesigned and standardized by Mr. Allen.